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ABSTRACT

The purpose of the seminar was to find some answers to, and a deeper understanding of the following questions. (1) What is the purpose or are the purposes of higher education? (2) What are the benefits of higher education to the individual and to society? (3) Can the outputs of higher education be named and measured? (4) Where is higher education going, where do we want it to go, and where does it need to go? Several issues were identified: (1) the summons to accountability by students, society, and the legislature; (2) flagging financial support; and (3) higher education's earlier overreaction to short-term needs. The papers in this publication deal generally with the problem of output. Papers by F. E. Balderston and John Vaizey survey the problem. The conceptual analysis of output is dealt with by David G. Brown, C. West Churchman, Alain C. Enthoven, and Kenneth S. Tollett. Some approaches to measurement of output are suggested by Alexander W. Astin, John E. Brandt, Robbin R. Hough, and John P. Miller. A bibliography and a list of participants are included. (AF)

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OUTPUTS OF HIGHER EDUCATION:
Their Identification, Measurement, and Evaluation

Papers from a seminar held at Washington, D. C.,
May 3-5, 1970, conducted by the
Western Interstate Commission for Higher Education
in cooperation with the
American Council on Education
and the
Center for Research and Development
in Higher Education at Berkeley.

Edited by
Ben Lawrence, George Weathersby, and Virginia W. Patterson

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. . . to help universities and colleges improve both their programs and their management.

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To design, develop, and encourage the implementation of management information systems and data bases including common data elements in institutions and agencies of higher education that will:

- provide improved information to higher education administration at all levels.
- facilitate exchange of comparable data among institutions.
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The Western Interstate Commission for Higher Education, the American Council on Education, and the Center for Research and Development in Higher Education at the University of California, Berkeley, present the papers of a national research training seminar on the outputs of higher education held in Washington, D. C., May 3-5, 1970. This seminar was jointly supported by grants from the Bureau of Educational Research of the United States Office of Education, the ESSO Educational Foundation, and the National Science Foundation.

The quality, effectiveness, and costs of higher education are discussed and much debated today. While the resources required to run an institution of higher learning have been described and accounted for in detail, very little agreement is to be found on the measured benefits to society and to the individual from the use of those resources.

Planning to accommodate the sheer volume growth in the educational enterprise is a demanding task in itself. Persuasion of the need to finance that growing enterprise is a still more difficult task and requires better information than is presently available.

We need more specific and more meaningful descriptions of the entire process of higher education. We need to see resource inputs, activities in the educational setting, and outputs of higher education as related parts of a whole. We are looking for insight and understanding of just how the contributions, activities, and benefits of higher education may be shaped, modified, directed, and improved through intelligent decision-making and informed allocation of resources.

With these concerns in view, this research training seminar brought together administrators active in higher education, students, legislators, researchers, and quantitative analysts who have been actively concerned with these problems. These individuals reviewed and commented upon prepared papers and discussed immediate, critical questions.

We gratefully acknowledge the contribution of the authors of these papers; the seminar commentators; the invited speakers; and the staffs of the Council, Center, and WICHE for planning and conducting the seminar.

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INTRODUCTION

INTRODUCTION: Now Where Do We go?

"Our mandate is clear . . . We are going to have to prove that we deserve the dollars spent on higher education and justify our asking for each additional dollar," says an educator.

What is the function of the university community in a free society ordered by law? Our notion of university as an ivory tower gave way to the idea of university as an open marketplace for ideas. Recent campus activities seem to suggest that the image of university as marketplace may be replaced with the concept of university as an instrument of social change.

What are the purposes of higher education? Is the university's primary responsibility to society? Or to the students and faculty engaged in the academic enterprise? Does the structure of the university serve the purposes of the university? Are the resources of the university committed to its purposes?

Self examination has been forced upon our institutions of higher education by alienated students, disaffected faculty, dissatisfied legislators, disenchanted alumni, and disappointed parents who are challenging the university.

Thorny as these questions may be, they are being asked. They are being shouted. And the answers are being subjected to unprecedented scrutiny and debate. Both internally and externally. the university is being called to accountability.

To the problem of accountability, add the difficult problem of financing higher education. Spiraling costs, increased enrollments, and tight money compound the fiscal crisis which confronts university decision-makers. Money spent to hire more teachers is not available to improve salary of existing faculty. Money spent to beef up the engineering program is not available to improve curricular offerings in the fine arts. Money spent to equip offices of added personnel is not available to buy bookcases and files in existing staff quarters.

The modern university decision-maker is swamped with problems, files of facts, and mountains of requests. So much has been said, recorded, published, televised, and proclaimed about the academic community that, certainly, there is no lack of raw data. But presently the man who must make decisions for his institution is not given much help. Despite the abundance of facts, they are not sufficiently useful. They have not been selected and aggregated in manageable form.

Accumulation and analysis of information will never replace judgment. Only the decision-maker can reflect the priorities established for his institution. But there is no doubt that more meaningful information would assist the man-on-the-spot as he faces tough choices:

Does establishment of the new degree program in the graduate school mean that the undergraduate program in the same department must simply mark time for another year?

Will the extra cost of tutorial services for minority students mean that hiring counselors for incoming freshmen will have to be postponed?

Much more is demanded of the college president than the academic credentials and experience noted on a job description. Horse sense, persuasion, and the gift of prophecy are valued requisites. In addition to what is expected of him as a public figure, he is charged with the responsibility of maintaining rapport with his faculty through displays of scholarly attainment, savvy with the legislature, and skills of academic governance. With students he must evidence courage, candor, and conscience.

Small wonder that the man of whom so much is asked is beginning to ask for help himself. He is looking for insight and understanding of just how the programs of higher education at his institution may be shaped, modified, directed, and improved through informed decision-making and intelligent allocation of resources.

In search of meaning and understanding of the process of higher education, educators, administrators, students, legislators, and analysts representing various types of institutions and geographic areas knocked heads at the WICHE MIS Seminar, "Outputs of Higher Education—Their Identification, Measurement, and Evaluation."

Initially there was little agreement within the group. Their task was enormous. Each man contributed to the discussion according to his own experience. Gradually, a form of consensus emerged on the issues which have produced the present problem. Then discussion turned to the substantive considerations of the seminar, but consensus was not reached on answers to the cosmic questions raised:

What is the purpose of higher education? Is there more than one? If so, what are they?

What are the benefits of higher education? To the individual? To society?

Can we name the outputs of higher education? If we can name them, can we measure them? How?

Where are we going? Where do we want to go? Where do we need to go?

It was characteristic of seminar participants that each question received full debate. There were no sacred cows at this meeting. Divergent ideas and perspectives were heard and considered. While no general consensus emerged from the reasoned discussion, a far more precise picture of the task ahead developed.

The agony of considering this problem did not remove the need for continuing to attack it!

The Issues Identified

Summons to Accountability

Something has happened on the American campus in the last decade, something has happened that has never occurred before in the two hundred year history of higher education in our country. A set of circumstances and conflicting interests met head on and brought the campus scene into sharper public focus than ever before.

Consider the actors on stage in this drama of discord and confrontation.

The student finds much of the teaching in his classes irrelevant to the world he sees, unresponsive to his needs and to the needs of society. Enter student activism. Demonstrations, demands, and political activity are the order of the day. For observers of the campus scene, the panty raids, goldfish-swallowing contests, and phone booth-cramming marathons of the past acquired a nostalgic aura of approval of college high jinks as they "ought" to be, compared with the political activism of the present. The new generation of collegians not only questioned the legitimacy of curricula, but questioned the very purpose of the university, demanding a voice in determining degree requirements and use of time in the academic community. Students wanted a voice in determining every aspect of campus environment and student life. The notion of university acting *in loco parentis* was first to go. Then, exit homecoming parades, school spirit, the fun and frolic of campus life. Farewell the bonds of group associations. Bye-bye the automatic respect accorded a professor. Up! the student individual.

Having implored generations of students at graduation to go forth into the world, questing to make it a better place, the faculties of our colleges should not have been surprised when collegians accepted the challenge. Trouble is, students jumped the gun and decided not to wait till graduation to improve the world. They included the university in the world and wanted to "improve" it, too. Admissions policies, grading, examinations, the lecture system came under student fire. When a moral crusade is waged away from home, it is easy to support. Aimed directly at you, a crusade becomes threatening, no matter the validity of its cause. A growing rumble arose from the faculty row, "Just what *are* these kids here for?"

Heard off stage: Mutters. Grumbles. Then, outraged cries of distress from the parents of the present collegiate generation. Parents first, they are taxpayers second. Spiraling costs of living vie for attention with increasing unemployment. Federal income taxes are taking a big bite and there seems to be no relief in sight. Americans are going to Vietnam and Americans are going to the Moon, but Mr. Middle America is going no place. Instead of his annual vacation trip, he stays home and works on his yard. Frustrated by rising expectations, strapped for funds, he looks to his state legislature for a little help on tuition for his youngster attending an in-state college. And what happens? Tuition increases, up and down the line.

Now, take a look at the state legislator. His judgment and vote become the referees in a rough and tumble competition for the public dollar. Everybody wants public money for a pet project. Health and welfare programs require a fresh infusion of state funds. Junior colleges are continuing to spring up. Former junior colleges are becoming four-year, baccalaureate, degree-granting institutions. New dormitories are needed on *every* campus — and more classroom space, more money for salaries for more faculty members! As one educator pointed out, "The problem has been clearly put. It's mental health against education, education against welfare, housing against education, and the problem is that every one of these goals is good. Some are more immediate than others, but who is to say that investing in housing is wrong?"

Each member of a state legislature has a difficult job to do. Mindful of the squeeze on his constituents between heavy federal taxes and the increasing costs of paying for primary and secondary

education through a property tax, he is prudent and watchful of expenditures at the state level. With all the clamor and competition for the state dollar, he is skeptical when he is asked to overlook — or look beyond — the chaos which he observes on campus and vote dollars in support of higher education at that institution. Already sensitive to the problem, just one more demonstration, one more insult to an invited visiting dignitary, or one more faculty protest about a loyalty oath and he finds himself asking (and being asked), "Is this what we are spending money for?"

As never before, the university is being asked to justify itself — its purpose, its methods of achieving that purpose; its allocation of precious resources; its priorities; its responsibilities to the individual and to society. Yes, both from within and from without, institutions of higher education are being called to account.

Flagging Financial Support

In the past decade higher education witnessed a growing reluctance on the part of state, federal, and private sources to finance its operations. Granted the impact of competing demands for the same dollar, granted the effect of an inflationary spiral of costs, perhaps the single most significant factor contributing to the lagging financial support of higher education was the growing public disaffection with campus disorders and with the objectives of higher education as they were perceived by the public. With intellectually elite young people earning entrance to a university, legislators are disgruntled to see the universities admitting only the cream of the intellectual crop and then not challenging these academically elite students to do something with their lives. Summing up this feeling, one legislator said, "Legislators are concerned and frightened by the doctrine of elitism which says that, because you have selected the elite, they should be canonized. If you have *that* kind of school you have a right to be concerned. We want you to manufacture elites, not canonize existing elites on entry. If they are just going to mark time for four years, O.K. Let them live it out. But don't expect public money! In fact, if you do not challenge students to do something productive with the years spent in college, expect cowboy wrath. We are going to close them out!"

Not only politically, but financially, higher education stands in the jaws of a vise. On one hand, the costs of every component of institutional operations are rising — interest rates, salaries, supplies, services, insurance. Costs are climbing steadily and have already reached historic heights. On the other hand, income from all sources is either falling behind or is increasing at a rate too slow to keep up with burgeoning student enrollments. One alternative popular with governing boards is to pass more of the cost on to students in the form of tuition increases. One consequence of this decision is to quicken student realization of the major share of the cost of education they are already bearing and, therefore, to step up their demands for a meaningful role in the governance of institutions of higher education. Thus, we hear students saying, "We are paying for this education. Give us a voice in determining the kind and quality of the education available. What you say about education to appeal to the legislature is not what we want to hear."

Though recognizing the validity of the statement, "He who pays the piper calls the tune," the university is caught on the horns of a dilemma. What do you do when *two* people who pay the same piper call for different tunes?

Overreaction to Short-Term Needs

Higher education is paying the price now for an earlier overreaction to the immediacy of a pressing problem. What military disaster or social chaos was averted by our national response to the challenge of Sputnik, God only knows!

The problem is one of "overkill." Educators were delighted to receive massive federal subsidies in the physical sciences and engineering, but that delight paled when they noted the distortion in the composition of their student bodies and curricula. To their dismay, the supply of graduates in those fields is no longer responsive to the employment needs of business, industry, and the non-defense sectors of government.

Our information systems were not sensitive enough to forewarn us of the consequences of a narrow emphasis on the technological aspects of higher education, of the neglect of the humanities which inspire and temper our values, and of the disregard for the forces of the supply and demand for graduates in a specialized area. As a result, graduates of many fields are currently facing severe employment problems. They are directing their despair and disillusionment toward their institutions of higher education. The absence of reliable information on employment opportunities is a significant source of student dissatisfaction.

Higher education now faces the problem of stimulating thought and activity in that province of human endeavor which deals with man and how he has learned to live with other men; how he expresses his values; how he perceives beauty, truth,

his environment; how he behaves and why; how he uses his leisure; how he finds meaning in life.

Added to the problem of financing higher education and restoring a balance in curricular offerings, the university is going to have to be far more aware of the demand for jobs that it is preparing students to fill. A management consultant observes, "As we look ahead from this day on, I think higher education is going to have to be much more concerned about the market for the product. It is going to have to be concerned about its product mix. I submit that higher education is on the threshold of major marketing problems. Now we are looking at a lessening of that market and this year and, perhaps for several years to come, we are going to have unemployed, and quite a few underemployed, Ph.D.'s. I do think educators owe it to their customers to let them know something about the demands of people in various disciplines and what some of the rewards, both monetary and intangible, are going to be in pursuing the various disciplines."

One Response to the Demand For Accountability — the Use of Activity and Output Measures

By legislators, by hard-pressed taxpayers, by a crusading press, universities from coast to coast are being told to measure the effectiveness of their efforts and the cost required to produce that effectiveness. "Define quality and then tell me if you can deliver it for two cents a ton cheaper," prods a state fiscal analyst.

"Do it yourself or we will do it for you," is the general promise.

Understandably resistant to pressures from within and without, institutions of higher education are nevertheless coming to an understanding that it is far wiser to be part of the process which suggests forms of measurement and identifies the areas of measurement. The WICHE MIS Program is built on that belief.

Now as ever before, educational institutions are committed to the use of reason. What, then, does the use of management information and analysis offer the university decision-maker? Management information and analysis add a new dimension to reason, providing the power of fact and reality to the wishes and aspirations of the institution.

Our current challenge is to focus our collective reasoning and analytical abilities on the serious problems that are fraying and unraveling the very fabric of our institutions. We need to understand the roles of various decision-makers as they affect higher education — including the roles of students, faculty, administration, legislators, government officials, community representatives, representatives of private industry, alumni, and others. Furthermore, we need to understand the important attributes or characteristics of higher education as viewed by each of these decision-makers. Understanding and description are important first steps to the measurement and evaluation of the activities and outputs of higher education.

Recognize Important Attributes

Before we can measure an activity or an output, we need an operational, unambiguous definition of that activity or output. If one is analyzing a transportation company, one might consider relevant attributes to be the origins and destinations of the load, the time required, the cost, the volume or dollar value of goods carried, the reliability of service, and the average damage or loss in transit. Undergraduate education as viewed by the state might be characterized by many of the same variables. However, students might consider their educational experience summarized by their chance of successfully completing their degree program, the proportion of courses which they may elect, their chance of marriage, the level of social concern of the peers, the accessibility of faculty members, the cost of attending the school, and other factors.

The major point of this discussion is that different roles have very different perspectives of the institution and a different set of descriptive attributes is appropriate for each decision-making role. Therefore, in our analysis of the major challenges our institutions face, it is critically important that we identify all of the relevant decision-making roles and then choose the attributes appropriate to each role. For example, if a college or university is seeking to increase its service to the minority communities, it not only needs to count the minority students enrolled and their grade point averages, it also needs to look at the school from the student's perspective and see what kinds of social groups and activities have evolved, the degree of stress and acceptance, the attitudes of administrators, and so forth.

Measures for Attributes

To enable each actor in the drama of higher education to play his part to the best of his ability, we need to provide each individual with personally relevant information. However, we need to devise

appropriate measures for the attributes which characterize higher education from each major decision-making perspective before we can provide the requisite information. It is easy to count heads or add up grade points, but it is much more difficult to develop a measure of student or faculty stress or a measure of their sense of control of their own environment. At this point, we can draw upon experts.

Evaluation of Activities and Outputs

A comprehensive, operational taxonomy of the attributes of higher education provides the basis for operational definitions and measurement of institutional activities and outputs. However, the relative values of each activity and output need to be expressed before an administrator can consistently choose between alternative policies or expenditure patterns. For example, the expenditure of an additional $100,000 might enable an institution to produce either two additional M.D.'s, or four additional Ph.D.'s in physics, or 25 additional Ph.D.'s in French. Which path should the administrator choose? In other words, how much should the administrator value one more doctorate in medicine, physics, or French? There is no easy answer for the administrator — he must turn to his conscience, to his constituency, to his advisers, and then synthesize a set of priorities that he is willing to act upon. However, once he chooses an operational set of values or weights, these numbers should be included in the activity and output accounting system and reported to the administrator as a guide to action. Therefore, the accounting and reporting system based upon this taxonomy of attributes and measures should also include the framework or mechanism which explicitly incorporates the decision-maker's values.

Decision-Making Aided

The basic assistance to decision-making that the use of activity and output measures offers is one in which a person, faced with a difficult resource allocation decision, seeks to think through his problem very carefully. He first identifies the characteristics of higher education that are important to him and then selects an appropriate measurement technique. By associating relative values with each attribute he is then able to identify the most desirable course of action. This process does not replace or denigrate the position of the decision-maker, just as power steering or power brakes do not obviate the role of an automobile driver. However, this approach to decision-making does extend the capabilities of the decision-maker, just as power steering or power brakes augment a driver's own expression of control. Actually, the position of the administrator should be enhanced because his understanding and control of his system is increased and facilitated.

A major advantage of this approach is that institutional objectives can be expressed operationally in terms of the attributes ascribed by the decision-maker to his institution. In practice, these objectives can be articulated either as specific targets or as relative values or intensities. For example, instead of saying every student should be able to read, we stipulate the specific target that every student should score at least 625 in verbal ability on the SAT or GRE test. We might indicate that verbal ability is twice as important as mathematical ability, or vice-versa, and make our resource allocation decisions in light of this choice.

This general approach contributes to the resolution of intra-institutional conflict by enabling conflicting groups to separate a decision problem into its elements. The conflict may result from differences over choice of attributes, measures, or weights. In either case, the conflicting parties can draw a line of demarcation around the areas of agreement and concentrate their attention on the essence of the dispute. This might rise to create new alternatives, separate activities, or some other resolution. At least, this approach would map the terrain of conflict and identify the problem areas.

On the technical side, the characterization of the different decision-makers' systems provides the basis necessary for various quantitative analyses, analytical modeling, or management information systems. These analytical developments are hindered by our inadequate understanding of the nature, attributes, and problems of decision-makers of higher education, rather than any technical limitations. Mathematically elegant solutions are of little value unless we have asked the correct questions and applied the appropriate values.

Roughly Right or Precisely Wrong?

However, these advantageous observations should be tempered by justifiable criticisms. Some observers point out that our quantitative analysis techniques and measurement tools are still sufficiently crude and imprecise as to leave considerable doubt as to the validity of the measures — which is partly true. In response, one person said, "I realize that taking the temperature doesn't prove that you are intelligent but taking the temperature

shows that you may not be dead." Furthermore, in the words of Alain Enthovan, "It is better to be roughly right than precisely wrong."

While it seems obvious that serious attempts will be made to identify and measure the activities and outputs of higher education in the next several years, there are those who seriously challenge whether it is a feasible course of action. They recognize that some of the outputs of higher education are easily identified and probably can be measured. However, they argue, "Rather than being merely unsophisticated in the identification and evaluation of the units of output, it is possible that there are simply no original units of output which actually exist for us to measure." If we cannot identify all of the benefits of higher education, how big is the whole of the benefits of higher education? Is it appropriate to assign costs of higher education only to those benefits that can be identified?

In response to this philosophy, the proponents of measuring the outputs of higher education indicate that we do not normally, in the course of human events, pay out money for something that we cannot identify. When we make a purchase which has side benefits, we do not normally change our accounting structure to indicate that the benefit that we were originally purchasing costs us X number of dollars *less* because we got a side benefit with the value of Y dollars. We usually accept the windfall as an unplanned bonus. Proponents argue that higher education should look upon those benefits of higher education progress that cannot be identified and measured in the same way.

Can we attach values to the outputs we measure without first having an understanding of the purposes of higher education? There are those who argue that before we begin the measurement of the outputs of higher education, we ought to develop a clear understanding of the purposes of higher education. Then and only then would it be possible for us to determine a value for the specific outputs. For example, a specific output may cost $5,000 to produce. It may have very specific quantifiable characteristics, but if its production is not useful to the purpose of the institution, it has no value for that purpose.

Those who urge immediate attention be given to measuring the outputs of higher education concede that values must be placed upon the outputs in relationship to the purposes of higher education. On the other hand, they indicate that attempts to reach agreement on the general purposes of higher education today appear to be fruitless. If we wait for agreement on this course of action we may never do anything to improve our muddled state of affairs. They further argue that higher education must have some purpose, otherwise it would not continue to exist. The purpose of higher education can, from one point of view, be defined as the aggregation of those identifiable products or outputs of higher education. Looking at it from a purely analytical point of view, if we can define the outputs and describe the process between the inputs and outputs we have, in fact, not only described the system, but indicated its purposes from an empirical point of view.

Another issue is at what point we *should* measure the outputs of higher education? Should we attempt to measure the immediate products of higher education or the long-range benefits of higher education to society? Should we attempt to measure medical doctors *produced* or the quality and extent of *medical services* to our people? When looking at the institution from what one calls the public service point of view, measuring the health services provided to our people appears to be a justifiable approach. On the other hand, those who argue that we should measure the immediate products of our institutions of higher education point out that many factors other than the institutions and process of higher education contribute to the effectiveness of health services. They say that higher education cannot be held accountable for the health service system, that it can only be held accountable for providing trained medical personnel, research findings, and perhaps some areas of social activities that contribute to the development of good health services.

Another way of looking at this problem is to try to find one, two, or a relatively small number of overall indexes concerning the quality and quantity of the benefits of higher education or attempting to find a long list of measurable products of higher education. The proponents of measuring the immediate products argue that a few gross measures may provide some sense of public satisfaction but will not get at the long-range problem of improving the management of our institutions of higher education, nor of explaining to those responsible for supporting the institution why a particular course of action was taken within an institution. While members of the legislature and the public they represent may feel it wise to evaluate the product of a particular portion of an institution — considering its worth with the view of buying more or less of it — gross measures will not provide the sophistication necessary to make these kinds of evaluations. They argue, therefore, that a long list

of identifiable products needs to be measured in order to provide appropriate analytical tools to understand the process of higher education and the economics of its funding. On the other hand, we are told that "We must be aiming at something simple, we must not produce measures which cannot be understood by the public, by the government, by everybody at the national and local level."

In the Appendix to this publication will be found a list of instructional, environmental, research, and public service outputs of higher education with variables and sources of measurement noted. It was developed at a brainstorming session *after* the "Outputs" Seminar had been concluded. It is *in no sense* final and should be considered a working draft, a starting point for discussion and review. At the same time, a review of this presentation of the outputs of higher education will inform an interested reader of the direction our studies seem to be taking us.

Finally, there is the position that " . . . no amount of analytical studies is going to tell the American people how much to spend on higher education. That question has to be answered by the American people, looking into their hearts and saying, 'We know what the outputs really are if we would admit it and make a decision.' "

Conclusion

Educational decision-makers are seeking honest, viable responses to the issues of public accountability, flagging financial support, and an earlier overreaction to short-term need. They are seeking forthright approaches to the polarization of opinion about the role of the university in a free society ordered by law.

The urgency of our era exhorts higher education to an examination of purposes, priorities, responsibilities, and capabilities. Having made a decision to be both responsible and responsive to the needs of society and the individual, the first step toward meeting those obligations is a purposeful allocation of resources. There is no clearer reflection of the values and purposes of an institution than a review of its priorities in allocating resources. Such purposeful allocation will require a careful analysis of the activities, outputs, and objectives of higher education.

Surely we can do no less.

SURVEYING THE PROBLEM

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"What is the value of basic science and the value of the contribution to society of the scientists? What is the value of the learned person . . . in the professions and the arts? And . . . what is the value of learning about values in the setting of formal education? These are indeed issues of near-cosmic proportion."

"I retain a faith in a daring and only partly proved hypothesis: That the quality of life and the rate of economic and social development in a region or a nation is deeply connected to its willingness to support and honor the creative processes which result in new fundamental knowledge. At the broadest level of social comment, I would simply point out that there are two nations of the world which have consistently followed a very broad strategy of investment in the education of their people: the United States of America and the USSR."

"Certainly a major area of efficiency gain available to American higher education . . . would be to increase the achievement and success rates of students who presently fail to complete programs."

Thinking About the Outputs of Higher Education

F. E. BALDERSTON

Cosmic Considerations

As we consider concepts and measures (and perhaps proxy-measures) for the outputs of higher education, we will be dealing with social questions of almost classical majesty. What is the value of basic science and the value of the contribution to society of the scientists? What is the value of the learned person not only in the sciences but in the professions and the arts, both to himself and to society? And, even, what is the value of learning about values in the setting of formal education?

These are indeed issues of near-cosmic proportion. But we will have to skirt some of them, and others we will have to work on in the spirit of prosaic, detailed analysis rather than that of the great social critics and philosophers of education in the past: Bacon, Jefferson and Franklin, Cardinal Newman, Lowell and Eliot, John Dewey; and in our own time, John Gardner and Clark Kerr.

The Bill Is Presented

In a way, it is ironical that this conference takes place in 1970, a century after the great expansion of higher education began in America, or even that it occurs in 1970 instead of in 1945, when the last and biggest increment of this expansion began to get under way. But now is the time when the bills are arriving and appearing oppressive — to the public decision-makers, to those who seek to sustain higher education in the private sector, and, not least, to the students! And now is the time when a wide variety of new analytical and planning techniques are being brought to bear in a professional way on the problems of managing individual colleges and universities and managing higher education as a series of regional systems and as a national system.

All of us have reason to be concerned about the costs and resource requirements of higher education. Much of our work, in fact, has to do with efforts to improve the methods of accounting and information assembly which will permit better description and analysis of these costs—costs of higher education as a sector of activity in the nation, from the point of view of institutional costs and the costing of particular programs within institutions and from the point of view of the cost of education as seen by the individual student. But we have bumped hard into the question of output and its measurement because, among other things, we are seeking now to link the resources used to the results achieved — in other words, to link inputs with outputs. It turns out that in the long history of concern about the processes and activities of education, we have achieved only a very imperfect grasp of the nature of its results. We are having to tackle the problems of output definition and measurement under forced draft, for higher education has come to the front of public attention both as a major social problem and as a major contributor to social change and economic development. Higher education is seen as perhaps the most significant gateway to individual mobility and place in our society. Over the next few decades, it is seen as demanding a sharply increasing share of gross national product. It is seen as demanding resources under conditions which are, at the present time, not satisfactory to the providers of these resources at the state, the national, or the private level. The job we have to do is urgent, important, and controversial. If we had time, we might do well to sympathize with ourselves for taking it on.

The papers and discussions scheduled for this conference are intended to cover eight individual topics and the linkages between them: four clienteles for output are seen (public, private, faculty, and students) and four major functional areas of educational activity are to be covered (undergraduate education, graduate education, research, and social involvement). I'm sure that we will benefit by this configuration of probes into the perplexing question of higher education outputs. In effect, what we are talking about is the need for operational definition and the means for measuring the goals or objectives of this system or series of systems of social activity.

It must be said at the beginning that higher education will go on, in some fashion, whether or not we and others like us succeed in obtaining improved definition of outputs. After all, it has survived for a long time without the kind of effort toward developing a rationale that we are undertaking now. But I think we can reasonably ask ourselves who will be interested in the outcome of our efforts to define and measure outputs? The clients for our efforts appear to be many, and the kinds of answers they may be seeking will not necessarily be obtained by a single mode of inquiry. First, there are the national and state public

policy makers and resource allocators who are concerned with major commitments of public funds to the various activities carried on by institutions of higher education. Second, there are the trustees, presidents, academic decision-makers, generally, and faculty and students, in particular, of the individual colleges and universities. They have urgent demands for information pertinent to the decisions they face, and they have fears that the solutions to output measurement problems which we may propose may profoundly affect their institutions.

Most generally, there are the representatives of various public and private clienteles who feel, mostly rightly but occasionally wrongly, that higher education has an impact on them: employers of the trained talent which comes from colleges and universities; users of basic and applied research findings which flow from scholarly activity; participants in the culture and the value controversies of society, who inevitably link themselves with the culture-creating and -sustaining activities of our colleges and universities; and citizens at large who, as parents, taxpayers, and critics, display a kind of fascinated ambivalence about the importance and also the hazard of higher education in these troubled times.

Social vs. Private Benefits

Perhaps the broadest questions relating to the outputs of higher education revolve around the distinctions between the social benefits of higher education and the private benefits accruing to business firms and to the individual student and his immediate family. Throughout the discussions at this conference, it can be anticipated that the problem of distinguishing between social payoff or gain and private payoff or gain will be troubling. So far as instructional outputs are concerned, should we regard them as having to do only with the gain in money income or at least in individual utility for the student? Or must we also take into account a wide variety of implications for the broader society? When an individual scholar or an organization in a college or university produces new knowledge or creative insight or engages in public service, who are the clients for this activity, how do we assess the direct benefits to them, do they pay for the work that is done, and what are the secondary impacts, if any?

I want to make a few comments about the question of social payoff in research and public service before I move to some discussion of the issue of social versus private benefit to the student.

We generally have a presumption that a new fundamental research result in the sciences, a new musical composition, or a feat of historical or critical scholarship has cosmopolitan consequences. The more fundamental it is, the more cosmopolitan, almost by definition. This would seem to argue that the public investment in basic research has to be made by the broadest jurisdiction available — the national government, a philanthropic organization operating in the national interest, or even a body representative of supra-national concerns. Yet we observe that the appropriate jurisdiction for making the decision to invest in the creation of new basic knowledge is often unavailable — there is not a potent and well-funded world organization for the support of basic research in mathematics, to use just one example. What has to happen is that decision-makers whose sources of support for research activity are much more localized than the incidence of cosmopolitan benefit is, must make these investments in new basic knowledge. For a large country, much of the cosmopolitan benefit can be captured for the nation as a whole, and this is part of the rationale for the existence of national programs for the support of basic research, as in the case most prominently of the National Science Foundation. But even this jurisdiction has an inadequate level of funding for the work that basic researchers may seek to do, and we observe that out of their own precious and limited resources, private universities function to support basic work, and public institutions, drawing support quite substantially from state government, also support a lot of basic research.

My own belief is that this is indeed appropriate, even though the cosmopolitan gains will eventually diffuse over the world of civilized men. But the rationale that I would offer comes in two parts, both of which are difficult to substantiate analytically and still more difficult to make thoroughly plausible to the man in the street. The first element of this rationale is that the rate of diffusion of new basic knowledge is not instantaneous, and that a locality or region or individual nation takes gains from leadership in basic research which are, while temporary, of great importance to the vitality and progressiveness of thought and of the applications of knowledge in the region or nation. The second part of the rationale is that in the long run, the very capability to offer serious education to young people is dependent on their involvement, and that of their teachers, in a combined research and instructional process in which the linkages between the two produce a necessity for doing the one in order, effectively, to do the

other. As to the rate of diffusion of new knowledge, I retain faith in a daring and only partly proved hypothesis: That the quality of life and the rate of economic and social development in a region or nation is deeply connected to its willingness to support and honor the creative processes which result in new fundamental knowledge. This may not be true, as a matter of priority, for nations which are in the early stages of modernization, but it seems to me to be clearly true of the United States, of the advanced nations of Europe, and of Japan. I would even claim that the advanced regions within the United States owe much of their eminence to the lead which a critical mass of scholarly productivity provides. As yet we do not have a fully developed theory which will demonstrate the differential rates of economic and social development that can be achieved under circumstances of varying rates of support to the scholarly process, and our dilemma is that until we have such a demonstrated theory we must, nevertheless, try to put the case for the support of fundamental work as a matter of faith, or we must reconcile ourselves to a very much more prosaic sub-optimizing strategy which would reduce the priority to basic research.

This problem of regional development rates needs further work in order to prove or disprove the regional hypothesis and in order to give a basis for placing the locus of resource allocation decisions as nearly as possible in tandem with the locus of broad social benefit. The regional vs. national hypothesis is of special significance in the United States because the states have traditionally suplied a very large part of the public money for higher education — and this, in the face of substantial rates of migration of people and ideas.

Two Nations Supportive of Investment

The differences between social payoff and private payoff in the instructional process are of even greater conceptual importance, but may be somewhat easier to deal with. Here again, I tend to be a broad constructionist and argue that social benefits very frequently exceed private ones and that educational strategies should be based on this approach. At the broadest level of social comment, I would simply point out that there are two nations of the world which have consistently followed a very broad strategy of investment in the education of their people: the United States of America and the USSR. They have done so under very different ideological banners and very different forms of government. It seems to me that, as nations, they have both been able to capture the great bulk of whatever excesses of social over private benefit existed because their rates of out-migration of persons have been low, relative to their domestic populations; second, the accession to eminence; and, further, the accumulation of power by these two countries in the twentieth century has been impressive and even terrifying to other countries. I believe that the broad strategy has paid off.

Another view is that there is no excess of social over private benefit. The student as private beneficiary should therefore pay full cost of his education, except for smoothing of access to loan capital and possible provision of subsidy to those of low income. It seems to me that had the theories of Milton Friedman and other proponents of this alternative view been controlling in the United States for the past century, we would have had a great deal less total investment in human capital than there has been; and to the extent this investment did occur, it would have resulted in a great deal of reinforcement, from generation to generation, of entrenched economic and social advantage.

Professor Howard R. Bowen, whose writings on the economics of higher education are familiar to many of you, has written a paper recently which I hope will soon be generally available. It is called, "Finance and the Aims of American Higher Education," and in it Bowen has an appendix, listing what he feels are important types of social benefits (as distinct from private benefits) of higher education. Bowen lists an even dozen types of social benefits from instruction, and he also points to social benefits from the colleges and universities as centers of research and scholarship, from their presence as pools of versatile talent, and from their activities as patrons of the arts.

It is one thing for us to make these claims of the social benefits of instruction, but quite another to find good measures for them. If Bowen's list is nearly correct about the conceptual elements to consider, we will need information about the post-graduation activities of former students so that we can construct indices of civic participation, cultural interest, choice of occupations having intrinsic social value but not high market income, and other social factors. The important issue here is: *What difference does an exposure to higher education make* in the life patterns of those who get it? Education is a transformational process, both as to the social benefit and the private benefit conferred, but I am inclined to think that its transformational character may be even greater on the social benefit side.

Student Progress Viewed

The student's passage through a particular educational program can be viewed in three ways at the time he completes it. He meets a *standard of competence or certification;* he may be rated among those who pass in *relative performance* ("number one in the class"); and his final performance can be gauged in relation to his level of capability at the time he began. Let me make a few comments about each of these.

For many purposes, the fact of earning a B.A. degree or a Master's degree may be more important to the student making his way in American society than the reputation of the institution where he earned it, or how well he did relative to his classmates, or what he actually learned. The certification effect seems to have real importance, both to the student's self-esteem and to his early opportunities for job placement. For an institution, the number of earned degrees produced in each type and level of program is an important measure of its achievement.

What significance has the relative measure, as in the class ranking, or the award of Phi Beta Kappa? Based on the internal competition among classmates at a given institution or in a given program, it is a competitive signal both to those rated high and those rated low. It is also very easy for the student, the institution, and the world at large to misinterpret. Employers are often very eager to obtain information about relative standing, but it would perhaps be a more acceptable measure if made against a larger population than the college class in which the student happened to find himself; in the context of internal, antagonistic competition the notion of exact relative standing has come under attack. The current academic climate condemns the more egregious abuses of competitive, grade-getting behavior.

The third way of viewing successful completion of an academic program is in many ways the most sophisticated and the most interesting: What has the student attained in relation to his capability at the starting point? This concept approximates *educational value-added.* It may be useful within an institution, particularly if there is reasonable assurance that the admission data and the evidence of the student's performance in the institution are reliable indicators. But it would be even more useful if there are external referents for both — e.g., C.E.E.B. achievement scores at the time of freshman admission and the scores on the Graduate Record Examination at the time of graduation from college. According to this view, the student and the institution together have accomplished more education if the value-added is great, rather than if it is small. According to this view, an educational process which moved a student from the lowest quartile of high-school achievement to the second quartile of college-graduate achievement would be accomplishing something tremendous, whereas the college which accepted students only from the top decile of high school achievement and delivered them into the top decile of college achievement would be doing relatively much less.

As we all know, status and reputation among institutions of higher education are mostly based upon absolute standards or, at least, upon the horse-back perception of what they are. If we can bring greater attention to educational value-added, we will accord more credit to the institutions and programs where substantial educational gain occurs.

The number of degrees produced by program and level, then, provides one measure of the amount of instructional output by an institution or a system; and I have suggested as another measure the amount of educational value-added obtained by each surviving student. This still does not deal with two problems for which current measures could be obtained: the amount of attrition, that is, the proportion of students who do *not* attain a degree and the interpretation of what they gain from educational exposure, even though they do not "succeed"; and the current measurement of the quality of education received. The eventual college drop-out has had at least one thing delivered to him which our society values greatly: the opportunity to try! In fact, we may very well find that as college-going opportunity is increasingly universalized, attrition rates will increase, and we will tolerate this to the extent that the opportunity to try is valued in relation to the cost of providing the educational exposure. From two other points of view, however, we have reason to be very concerned about the phenomenon of drop-out. Drop-out usually signals failure to the student, and it may exact a heavy psychic cost from him. And the investment cost of providing the educational exposure is largely unrequited, we have reason to believe, if the student does not persist to the degree. More research is needed on this question, but the fragmentary evidence that I have seen seems to indicate that in terms of market return, at least, the drop-out student has a later income pattern that is not very different from what it would have been if he had not attended college at all.

Budgeting Still Based on Student Flow

Certainly a major area of efficiency gain available to American higher education (as well as to elementary and secondary education, where there is an immediate social crisis over the issue) would be to increase the achievement and success rates of students who presently fail to complete programs. Yet educational budgeting in both private and public institutions is still very largely based on enrollment flow and not on the net output of those who achieve well. More knowledge of the reasons for drop-out and more attention to the design of educational programs to produce successful achievement would very probably pay big dividends. It is hard to interpret drop-out by students who could succeed in conventional terms, but who are repelled by conventional success and "making it," or prefer the Movement, or are in quest of a different life. We do not yet know how to confer dignity on downward mobility. I might add that our universities could very well have produced Pontius Pilate and the Scribes and the Pharisees. But what would they have done with Jesus of Nazareth?

Quality measures are also very much needed now, and they would become still more important if new emphasis were placed upon budgeting in accordance with the net output of degrees attained. (Many academic people express the fear that if budgeting were done according to degree output, success rates would be improved simply by reducing the passing standard.)

There is great cynicism about the educators' alleged preoccupation with educational quality. One prominent educational spokesman in California government put it this way: "Quality, shmality!", he said. He implied that whenever really embarrassing questions were raised about the amount of resources it took to do the educational job, or about teaching loads, or a host of other institutional practices, educators would defend the *status quo* by arguing that their practices were necessary in order to maintain educational quality. I have no sympathy for this man's view or the way he expressed it, but I do think that it is very urgent business indeed to find measures of the quality as well as the quantity of education.

At the present time, great reliance is placed on the status rankings and indicators of institutional reputation which are formed in people's minds from very fragmentary folk-lore impressions. Surely more can be done. At the crudest level, every graduating senior from every accredited institution could be expected to take the Graduate Record Examination or one of the analogous professional school examinations. By analyzing the resulting body of data, it would be possible to look both at the means and the distributions of each institution's graduates in relation to the whole population of graduates.

Finer measures of quality are undoubtedly needed. At some institutions, the administration seeks the judgment of outside visiting committees in each discipline so that something more will be available to them than the special-pleading claims of their own departmental faculties.

Longitudinal data concerning the jobs and activities of former students (both degree-winners and drop-outs) after they have left an institution would be very helpful in assessing what the students have really gained in educational output. There are bound to be serious arguments about values in the interpretation of such information, but it is needed both for improved institutional management and in the interest of accountability. Questions of the "whole man" and of character dropped out of focus for a time in favor of attention to the graduate's formal academic prowess. But events and our national agony should cause us to reinstate these issues. Three other value-loaded issues are bound to come up. One is the interpretation of the value to be placed on the education of women who later spend a major part of their adult lives in child-rearing rather than in the labor force. Is the educated woman who does not work simply a consumption good for her husband? That was the assertion of one economist I talked with, who saw no problem in requiring the husband to repay loans which had been used to finance his wife's education. I found this male chauvinism appalling.

The second issue that is bound to arise concerns the later migration of educated persons from the states where their education had been, in part, financed from state tax moneys. What interpretation are state authorities going to make of longitudinal information which discloses that a portion of the former student population has migrated elsewhere? Is the state cost of their education an unrequited investment of the state in question?

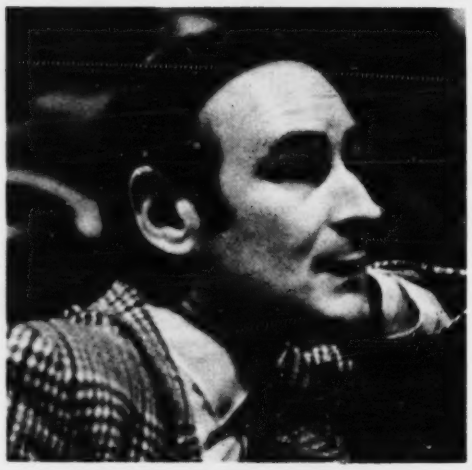
Finally, we must point to the deep collision of values between those who adopt conventional interpretations of the worth of education as preparation for highly valued occupations and those who argue that this is simply supporting a social system that needs trained and docile manpower, whereas the *real* point of education should be to prepare young people to reshape society. I have no easy

answer, but I will forecast that this argument will continue for some time.

Accountability Demands Selectivity

I want to comment, in conclusion, about the importance of output measures for the planning and management of the individual college or university. Much of what I have said bears on ways to view the individual student as an embodiment of educational output, but measures of the performance of populations and sub-populations of students who come out of particular academic programs can be interpreted as indicators of institutional performance. These indicators need to be joined much more firmly than they have been with decisions about priorities and resources.

Each degree program, each academic department, each research institute can be thought of as a contributor to the strength (or weakness) of the institution. Many of us are working on the slippery problems of costing. But costs cannot be gauged against too immediate a set of measures of student performance (or faculty research performance). It usually takes a great deal of time to build up a faculty *cadre* for an effective academic program, still more time for that program to achieve reputation, and still more time for resources to be withdrawn from a program that becomes obsolete or useless. What does seem to be important, especially in the formation and support of graduate programs, is to assess from the beginning what it will take to produce a critical mass of faculty and other resources that will be necessary to mount an educationally viable and economically effective program and to move toward this target level rapidly — until it is reached, costs are very high in relation to results. From the institutional standpoint, critical mass is also important because it provides a means of delivering institutionally-recognizable outputs, rather than outputs (in teaching or in research) which are attributable solely to individual students or faculty. I see no evidence that the decade of the 1970s will be very different for American higher education than the first year of the decade has been. If this is a valid presumption, the requirements for efficiency improvement and for courageous selectivity in the allocation of resources to competing programs will lay heavy responsibilities upon college and university administrators and faculty. Both external accountability and the necessities for coherent internal priorities will force a rapid increase of attention to the outputs of every institution.



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"I represent the "foreign" element in your meeting."

"It is interesting that the size of the public sector in most of the advanced industrial democracies is strikingly similar. Whether you examine an extreme social democracy like Sweden, a moderate social democracy like the United Kingdom, or an advanced capitalist country like the United States, the public sector seems to be roughly the same size. Furthermore, in all these countries, as indeed throughout the world, the bulk of education expenditure falls firmly within the public sector."

"Money incomes, however discounted, are not acceptable as proxies of educational output. Objective tests of achievement are acceptable, provided that they are appropriately weighted for student inputs."

The Outputs of Higher Education — Their Proxies, Measurement, and Evaluation

JOHN VAIZEY

First, may I say how honored I am to have received this invitation to come and address your meeting. The topic is one in which I have long been interested, and I hope that this meeting, together with others which are scheduled on the same topic, will enable us to make some significant advances in research in this area. My wife and children are American citizens, and I am constantly on the brink of becoming one. For me, therefore, though I represent the "foreign" element in your meeting, to speak in Washington, and to meet so many friends, new and old, is like coming home. I am doubly grateful, therefore, for your invitation.

My own work has been concerned with questions of measuring input and productivity, and therefore I have paid particular attention to the problem of output.* What I have hitherto done is to take for granted the question of output: to assume, that is, that if there are two alternative methods of achieving the same objective, the objective would be equally well or badly attained by either route. This assumption of constant output enables comparisons of inputs and comparisons of techniques to be made easily, since the mathematical formula which is required is obviously much simpler, and because economists then have no need to involve themselves in questions of measurement of output which raise issues of psychological and other forms of evaluation that are much disputed.

The Market Mechanism

The market mechanism, as taught in neo-classical economics, solves most of these problems of output measurement, subject to the acceptance of one enormous simplifying assumption. In the neo-classical economic system, money prices, both of input factors and of intermediate and final goods sold on the market, represent scarcities, and the crucial assumption is made that there is a constant marginal utility of money so that scarcities in one area can be compared with scarcities in every other area. It follows, therefore, that if a teacher costs $20,000 a year and teaches 20 children, the cost of that education is equal to $1,000 per year per child, and in a perfectly competitive market system the education would be sold at that price to those children and would — and here we come to a second crucial asumption — it would, for the marginal child, be worth exactly the benefit that the child derives from it.

Now there are many merits of the neo-classical system, particularly in its Austrian formulation, which has become so dominant a mode of economic reasoning in the United States. Chief among them is algebraic elegance and simplicity of policy prescription. If a paradigm of the market can be set up we have no need for proxies. Output is measured by the value that it is sold for, and inputs cost exactly what is paid for them. It follows that in a free and perfect market, the price of a year at school — say $5,000 — would be "worth" $5,000 to the marginal family, and that is all there is to it. The difficulty with this type of analysis is that, first of all, it rests upon assumptions which may well be questioned, such as whether or not there are perfect markets for factors and perfect markets for intermediate and final products, and secondly it avoids all questions of economies of scale, of monopsony, and of monopoly. But, thirdly, and above all, it leaves on one side the question of the allocation of resources within that very large part of economic and social life which is now the responsibility of public bodies.

Parenthetically, I may say that it is interesting that the size of the public sector in most of the advanced industrial democracies is strikingly similar. Whether you examine an extreme social democracy like Sweden, a moderate social democracy like the United Kingdom, or an advanced capitalist country like the United States, the public sector seems to be roughly the same size. Furthermore, in all these countries, as indeed throughout the world, the bulk of education expenditure falls firmly within the public sector (excepting only the somewhat controversial instance of income foregone by students while they are studying). This leads me to assume that the problems of measurement of input, productivity, and output in the public sector assume a similar importance for many countries despite differing ideologies — economically, socially, and politically. I take it, therefore, that the question that we are debating is one where

*The work to which I refer is *The Economics of Eaucational Costing,* in four volumes, of which the first three have either just appeared or will jointly do so, available from the Centro de Economia e Financas, Gulbenkian Foundation, 56 Avenida de Berna, Lisbon, 1., Portugal.

international experience is strikingly relevant and important. The case is different for a service that in one country is in the public sector and is out of it in another country. The National Health Service is an example here.

You will be aware, and it will doubtless be frequently mentioned in this Conference, that the technique which has become prominent for calculating the relationships of output to input in the public sector goes under the name of "benefit-cost analysis" or — something similar, "cost effective techniques." These techniques date, in essence, from Pigou's work on the *Economics of Welfare*, in which he drew attention to the indirect as well as to the direct consequences of economic activity, and suggested that these effects, which did not appear in the sector of society where money was the measure, could be estimated by analogy with money costs. Thus, in the field of water conservation and in the field of public transport, calculations have been made of the costs of substantial public installations and of the benefits that accrue, both directly to the consumers of the products by these installations and of the other indirect consequences. You will be familiar with the work of the calculation of the rise in income of a locality which develops because of improved transport facilities, the reduction in pollution which improved public transport services provide if private transport declines as a consequence, and so on. Mr. McNamara and others are responsible for extending this kind of calculation to defense, though I think it has become increasingly doubtful as to whether or not the calculations made in that field were either analytically satisfactory or in the end operationally viable.

Cost Effective Relationships Crucial

Increasingly, there has been a movement for other public services to come within the orbit of this type of analysis; indeed, with the spread of target budgeting, both in Canada and the United States, in which the objective is stated and alternative means of achieving the end are set out, the cost effective relationships become crucial determinants of public policy. It is, therefore, not surprising that the attempt has been made to bring these techniques into the field of education. Surprise is even less, I think, when regard is paid to the growing proportion of the national income which is devoted to education, which is now approaching 7 per cent in many countries, and to the crucial role that education plays in the provision of skills and in the determination of social mobility and other social characteristics of the population.

One point should be carefully noted. Benefit-cost analysis provides but small opportunity for contrasting different sectors of the economy; it is only applicable within sectors, and is there to compare and contrast activities which closely resemble each other. And another point that will become critical in the analysis that follows may often be forgotten. The valuation that is put upon the non-monetary benefits and losses is subject to dispute, as it has not been settled by the market. So, we can never escape an index-number problem.

I, therefore, wish to examine in some detail the question of evaluation of output. First, I think, we have to realize that we are concerned basically with three sorts of questions. The first is what can be defined as output? We have to remember that one of the outputs, namely the student who emerges from a system, is at the same time an input and also part of the productive process. If we therefore take the formula $\pi\ (S_i)\ S_o$ we find that there is a common element in all the symbols which are being manipulated. As I have argued, this is a matter which is fundamental and deserves, I think, very important attention, because it does affect profoundly the arithmetic, as well as the policy prescriptions, which might arise from the arithmetic. I think we have to consider very deeply the meaning of the words input, output, and the ratio between input and output which is variously labeled, "cost effectiveness," "value-added," or "productivity." For example, the input to a given year in college is the student's experience of the work of the previous year. One of the benefits or consequences that arises from the input is the actual experience or enjoyment of the year in itself. There is then the output, perhaps more conventionally measured, of the year which could be defined in terms of examination grades, or in other ways. It is very important to understand that these three separate stages are all closely linked with each other and, in some sense, indissolubly linked, so that to attempt to divide them out is to attempt to dissolve the indissoluble. I shall revert to this point later on in my speech.

I want to emphasize that far from knowing what is π and what is S_i and S_o, we could rephrase the formula in the form of ? (?) π ? which would give us a far more realistic description, in my view, of the process of education as it is carried on than some of the calculations that I and others have made.

It is extremely difficult to measure inputs, even when such relatively non-controversial methods as estimating the true costs of teaching are in-

volved. I want to call attention to this matter in relationship to international comparisons of educational outlay. Particularly, I want to draw attention to the question of evaluating student inputs. In the first case, you can simply take numbers of students, but since we know that the ability of different students to study is related to other socio-economic variables, the inputs of students have to be weighted by such matters as sex, race, socio-economic background, and ability. Ideally, as we all know, for comparing the progress of two students they should be similar in every respect. The extreme unreality of the assumptions becomes clear in any basis of comparison, since measuring the ability or previous educational experience, or even the socio-economic background of different students is not, ever, an unambiguous or uncomplicated procedure.

Nevertheless, I do not want to be too depressing. Techniques have been evolved for doing this which are perfectly well-known; and by an analysis of variance I think that substantial attempts at standardizing student entry can be made. Furthermore, for any one institution differences from one year to another are not likely to be substantial. Nevertheless, I want to make quite clear at this stage that already when we evaluate student inputs, we have an index number on our hands in the sense that we have weighted the input for different characteristics and the question of which weights we adopt will affect the outcomes.

Teaching Procedures Studied

The next stage is to vary the procedures by which students are interested, and I would draw your attention to the fact that Professor Torsten Husén has already said that so little is known about the different procedures of teaching that to contrast, say, teaching by television with "conventional" teaching procedures is itself an extremely summary procedure. In addition, I think that Larry Segal's work on the study of the influence of television has drawn attention to the fact that even in an area which would seem to be as relatively unambiguous as the effect of television instruction, the work divides pretty evenly into those who say that its effects have been beneficial and those who say it has not. As I recall it, this was a study of over a thousand papers and, therefore, his results are not unimportant, especially when they are contrasted with what is known of the difficulty of observing the classroom situation.

I want to say a little about observation of the classroom situation. Obviously, the ideal procedure for describing what goes on in the classroom is some attempt at participant observation. Of course, in universities dealing with students of university age we have ideal opportunities for this form of development; and there are well-known psychological procedures for calibrating and evaluating the different methods achieved by participant observation. I will not expound them here. I merely draw your attention to them and pass on.

I turn now, therefore, to the major question which is the theme of this Conference: outputs — their proxies, their measurements, and their evaluations. I have taken this long way 'round to reach the point because I wanted to emphasize that evaluation of the outputs is not independent of the evaluation of the inputs or of the procedures by which you reach the outputs and that, therefore, many of the techniques which are used for measuring the results of industrial or economic activity are not necessarily applicable to education. It may well be that the devices which we should use for this sort of judgment should be derived from the discipline of social anthropology or social psychiatry. This seems to be a realm which we should discuss fully.

Now the first and most important method of analyzing outputs is by simple numbers, by which you relate the number of students who go into a system to the number of students who emerge from a system. Until recently, for international comparisons, this was virtually the only method that we had and simple though it may seem, the process of achieving statistical conformity for comparing different nations is still in its infancy. Despite this, the crude comparisons between such things as the proportion of the age group that go into higher education in different countries and the proportion of the age group that drop out in different countries seem to me to be important and significant indicators when there are gross differences. Another measure which seems to me to be important in the school system is the number of repeaters; in many countries it is a common habit for children to be forced to repeat a year and this has a cumulative and deteriorating effect on educational outcomes.

The next series of procedures are tests and grades and examination scores of all kinds. Here we are faced with a number of complex problems. The first is the extent to which the examination results are consistent; evidence is widely known for many years that in the essay type of examination or the oral examination, which is common in Continental Europe, results given by different examiners

are highly inconsistent. Even the same paper graded twice by the same examiner will be given widely different grades. It may well, therefore, seem that objective testing is more important. But objective testing raises difficulties when it is used intertemporally, that is from one year to another, because of the way in which knowledge changes, and also interculturally in the massive educational achievements study which has its headquarters in Sweden, perhaps one of the most significant pieces of social research now being done in the world. It has been found difficult even to compare mathematical outcomes in different countries, and once such subjects as civics and civic education are raised, the problems become extremely complex. To give you an instance of the problem, may I put it like this? Supposing I asked children in twenty different countries, "Who is the father of your country?" The United States child might answer George Washington; the child in Russia might answer Stalin; the child in China might answer Mao Tse-tung. Now if we posed a question about Stalin, Mao Tse-tung, and George Washington in all three countries, the children would perform differently. Therefore, we have to find — if we are making a comparison between these countries — something which is culturally neutral with respect to all of them. In the Western world perhaps we might choose the Beatles, or some other group. But this, of course, carries with it the value judgment that what is special or particular to a particular culture is less important than what is common to all the cultures which are being assessed. This assumption is itself a value judgment which is not acceptable.

We then have to relate these tests and achievements to the inputs which are relevant. To take a particular example, in the mathematical study it was found that the Japanese performed particularly well and the Americans and Swedes performed particularly badly. The Japanese concentrated on a small percentage of the age group, whereas the Americans and the Swedes were undertaking the heroic process of attempting to educate a whole age cohort. It necessarily follows, I think, that as you go down the socio-economic scale and as you go down the attainment and ability scale which, as we know from socio-economic research, are much the same thing, the level of performance which can be expected will drop off. How do you weight the levels of performance by different strata of the age cohort? Again there are techniques for doing so, but I have to draw attention to the fact that the weighting we adopt will affect the output.

Weighting for Failure

We then come on to the question of failure. Supposing that for anyone taking a given test, 50 per cent succeed and 50 per cent fail. Do we weight for the 50 per cent who succeed as having attained 100 per cent of the objective and the others zero, or do we grade them according to the proportion of the ultimate objective that is achieved? One of the most common problems in examining is whether or not we are setting a level of attainment which all should achieve. The analogy which I draw here is with the examination which enables you to drive an automobile — an examination which, ultimately, almost all people who are physically normal ought to be able to pass. Or are we dealing with an examination which is designed to select only very few people of extremely high and rare talent, for example, the kind of test which might admit a potential ballerina into the Bolshoi Ballet? I am not suggesting that there is any one answer to this; obviously, there is not. What I am suggesting is that the kind of weighting that we adopt will affect the outcome and that this kind of weighting needs particular attention.

The next range of objectives for which techniques of evaluation exist are changes in personality and attitudes. Here again, there are considerable difficulties, both in testing before admission and testing after the conclusion of the course. We have problems not only of weighting changes in attitudes against the overt desire to change those attitudes, but also the problem of weighting character and attitudinal changes against academic performances. There are hosts of other values which are important and relevant — the general level of culture, sporting achievements, a whole range of activities which are assumed to be the aim of activities in universities and colleges. Bloom's *Taxonomy of Educational Objectives* is extremely helpful here, but it gives no guide to the relative weighting that should be adopted. I think the only answer that one can suggest for this relative weighting is the one of pragmatism, that what is inevitable and necessary is for the agreed objective formulation to be presented, much in the way in which a Bergsonian welfare function would be formulated.

$$W\ (U^1, \ldots U^v).$$

Income Related to Attainment

This brings me to the last but not the least important section of the theme that I want to develop before you. This is the evaluation of education output of the consequences of what happens to the stu-

dents. The best formulated and best known of these is, of course, the relationship between educational attainment and income. The procedure will be familiar to you, that the lifetime earnings profile of people of different educational attainment is related to those educational attainments, after standardization for other characteristics, which socio-economic background raises, and ability. I have argued elsewhere that this process of standardization is by no means as obvious a statistical procedure as it may seem because the variables in the relationship are very closely inter-related. I have been supported by Professor Herman Wold of the University of Uppsala, and Professor Torsten Husén of the University of Stockholm, in my suspicion that the statistical problems here are much larger than has been assumed in some recent work, and I would refer you for a full discussion of this theory to a paper which has been published elsewhere.

But this relationship between education and income, even if the problem of standardization is overcome, then presents formidable problems. For one thing, there is considerable statistical difficulty in extending cross section data into a time series. Secondly, the hypothesis upon which judgment is made, namely, that income differentials will remain the same, is open to serious doubt. Thirdly, the assumption that the labor market is functioning perfectly is even more questionable. Despite these difficulties, it might be argued that this kind of calculation is most useful and most important.

I have real doubts about this as a test of educational output; nevertheless, other people do support these particular techniques.

The question that arises now, I think, is the relationship which should be established between all of the outcomes of which I have spoken. In addition the question of pleasure and satisfaction, or of displeasure and dissatisfaction, which students themselves experience during their time at the university must be considered, for this in itself is one of the outcomes of the education process. I can only suggest as a technique the iteration of costs, techniques, and consequences in as full detail as possible, in order that they may be all weighed up together, according to whatever social welfare function seems suitable for the purpose.

That, however, seems too negative a line at this stage. May I perhaps make some concrete propositions to be accepted or rejected?

1. Money incomes, however discounted, are not acceptable as proxies of educational output.
2. Objective tests of achievement are acceptable, provided that they are appropriately weighted for student inputs.
3. Other characteristics that can be tested should be added to these objective tests of achievement by formulae that must be explicit and must be agreed upon.

Now, as to techniques, my one prejudice is very strongly in favor of longitudinal cohort studies. I realize that this is much more expensive than other modes of evaluation, but I believe that evidence — whether Husén's, the International Educational Achievement Tests, and Dr. Douglas's studies — all supports the notion that longitudinal studies are the best. It is my own conviction that other tests which are not part of a cumulative series tend to exaggerate the importance of one factor as against another.

Monitoring Necessary

This raises the difficulty, an obvious one, of how to do it. The more I study this question the more convinced I am that in my country — and presumably in other countries, too — we should have a continuous monitoring process for evaluating the results of education.

CONCEPTUAL ANALYSIS

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The Browns have a son and a daughter.

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"The challenge is to identify measures that meet all criteria, for as a rule consensus measures are not quantitative and additive, and quantifiable goals are not generally accepted. Pragmatically, achieving all characteristics 100 per cent is impossible. Compromise is essential."

"The growth that occurs within this collegiate environment may be, for the convenience of goal setting and measuring, grouped into five categories: Whole man growth... specialized man growth... growth in the pool of knowledge... growth in society-at-large... the joy of growing and being in an educational environment."

A Scheme For Measuring the Output of Higher Education

DAVID G. BROWN

Too long higher education has trusted the canard that " . . . college is good for you and benefits the nation" and has neither defined objectives nor measured response. Now donors and legislators are demanding proof. Now students question the wisdom of college for all. Now educators are presented with a plethora of teaching methods, subject matters, and educational environments without the tools to discriminate between the effective and the inefficient.

Timely it is for educators to define objectives precisely (Section 1 of this paper), to develop measurement devices (Section 2), and to offer a quantitative model for judging the success or failure, the adequacy or inadequacy, of higher education in attaining desired goals (Section 3).

How easy it would be to measure output as the number of blue-eyed students graduated, the number of words published on pink paper, and the number of times *Playboy* magazine was checked out of the library. These nonsense measures do not, however, value outputs or measure output in terms of objectives. To construct meaningful measures, statements of objectives must precede.

The Objectives

Universities provide multiple products. Fundamentally, the university is a growth environment. Here, resources are brought together for the convenience of the student who wishes to grow. Here, learning is more efficient because of the proximity, the extent, and the diversity of resources. Here, also, the scholar, as he strives to extend the boundaries of knowledge, is supported by the environment.

The growth that occurs within this collegiate environment may be, for the convenience of goal setting and measuring, grouped into five categories.

(1) *Whole Man Growth* — developing or reaching toward a value system, a familiarity with the heritage and the culture, an understanding of self, an ability with inter-personal relations, a life style and life goal. This growth may be achieved by many means, from experimentation with different life styles to a library-based study of life styles in various cultures. Normally this type of growth is the emphasis of undergraduate education. Component objectives include increasing the student's ability to:

A. Learn to feel (e.g., compassion, love, concern)
B. Learn to retain facts
C. Learn to think (i. e., logic, methods of analysis)
D. Learn to decide (i.e., philosophy of life, value system, methods of analysis)
E. Learn to act (e.g., do, create, communicate)
F. Learn to learn

(2) *Specialized Man Growth* — developing motivation and skill as a specialist, an in-depth understanding of one area of knowledge, a narrow expertise. This may be achieved through apprenticeship or through study of methods and styles of past masters. Normally this type of growth is the emphasis of graduate and professional education. Component objectives include increasing the student's ability to:

G. Choose a career
H. Gain admission to next stage in career development (e. g., medical school)
I. Develop skills needed to fulfill career
J. Earn a living for self and family
K. Fulfill society's manpower needs (including discovery of talent)

(3) *Growth in the "Pool of Knowledge"* — discovering new relationships, new phenomena, new materials for the purpose of stockpiling knowledge and broadening the base for further discovery. These discoveries may be in the research laboratory or off the campus, and by either students or faculty. This group of discoveries differs from categories one and two where the discoveries are more personal, the discoveries result from a new person entering territory previously mapped. Normally this type of growth is the emphasis upon research.

*Originally I outlined an article that might appear in the *American Economic Review*. Fragments of that "article" still remain. In the main, however, this paper is written to provoke discussion and to highlight issues rather than to be precise and fair in a scholarly manner. Rather than building from past literature I have chosen the more controversial technique of jumping beyond my data and describing a model that is still in its infancy. Hopefully in working back to hard fact we shall have insights on output in higher education. In writing this paper I am especially indebted to Dr. Curtis Page, Assistant Provost, Drake University, for his wisdom and encouragement.

Component objectives include ability to:

L. Identify new phenomena

M. Synthesize and summarize in new ways

N. Communicate new knowledge to others

(4) *Growth in Society-at-Large..*— applying knowledge to societal problems, relating discoveries in the laboratory to the market, reflecting on the value system of society-at-large. These applications, which advance societal welfare are providing: an educated citizenry, a trained corps of social agents, and a basic pool of knowledge. And the contributions are more direct. Here the university departs from its primary role as "capital builder" and provides a "current good" to society. Normally this type of growth is the emphasis upon social involvement and service. Component objectives include ability to:

O. Create design for new society (e. g., design model cities program)

P. Carry out design (i. e., provide manpower actually to do the job)

Q. Evaluate society's current attack on problems

(5) *The Joy of Growing and of Being in an Educational Environment*—providing income and a way of life to university employees, a joy-giving experience to students while in college, and a tinge of the intellectual environment to the city or town. This output is expressed by students as: "It's a hell of a good way to spend four years and a darn sight better than the army"; by faculty as: "I cherish the life of the mind and wouldn't consider working for industry"; and by community residents as: "I like living here because the university provides easy access to evening courses, dresses up the physical appearance of the town, draws many interesting people, and brings customer and tax dollars to town."

Component objectives include ability to:

R. Provide dignity, self-esteem, and material goods to the faculty and others on the payroll

S. Provide enjoyment and happiness to students and faculty involved in the educational process

T. Provide benefits, both psychic and real, to citizens of the community.

At the outset it is important to understand that Products 1-3 differ substantially from Products 4 and 5. Products 1-3 may be measured as *growth* or as the change in the value of a *capital asset*. Here, universities are producing goods that will, in turn, themselves produce other goods. Here, the economic theories most applicable are capital theories.

Products 4 and 5 are consumer goods, here-today-gone-tomorrow. Measurement is not of growth but of the joy and satisfaction generated at the moment of consumption. Here, higher education's contribution is measured in terms of the value *today* of, say, uncovering the radiation dangers of nuclear reactors or of restructuring income tax tables. It is measured in the psychic and real income received *today* by faculty and students. Consumption not growth is involved. Assessment of growth, with the requisite measures at the beginning and at the end, is not necessary. An analogy may help. To measure the growth in value of a manufacturing plant between 1965 and 1970, it is necessary to know a price at both points. This is the type of measure needed for Products 1 through 3. To measure the value of attending an art exhibit, it is necessary only to know the price of admission. Attendance at an art exhibition is a consumer good that is used up entirely at the moment, and that is the nature of Products 4 and 5. The values of Products 4 and 5 may be measured only at the point of output. The values of Products 1-3 must be measured as differences between values at input and values at output.

Measuring Objective and Output

Output choice and measurement choice relate closely. Unfortunately, broad consensus goals are immeasurable, and measurable goals lack general endorsement. The dilemma is arrogance versus imprecision. Avoiding catalog rhetoric and the lofty phraseology of committee reports, this quest is for an operational measure even more than a consensus goal. The technique will be to provide alternative measures for each consensus goal, thereby allowing the model user to employ those measures that are "operational for him" (i. e., he has the data) and "agreeable to him."

This measure must have these characteristics:

(1) *Quantifiability*. Output must be stated in objective, quantifiable units.

(2) *Additivity*. The output in Category "1" (i. e., whole man) and the output in Categories "2-5" must be stated in the same units so that total output may be summed.

(3) *Divisibility*. The measures selected for the system as a whole (American Higher Education) must be equally available and meaningful for subsystems such as private versus public higher education, higher

education in the state, XYZ University, the College of Law at XYZ, and a particular activity within the XYZ Law School.

(4) *Transferability*. The measurement system appropriate for 4-year colleges must also be appropriate for universities and for junior colleges.

(5) *Consensus Acceptability*. The measures should be credible. A majority of all constituencies — students, faculty, public, private — should agree that the measures are not inappropriate.

(6) *Flexibility*. To the extent that consensus acceptability of goals and measures cannot be achieved, model users must be provided with "mix and match" output measures. A state planner, for example, may wish to measure change in tax revenues due to higher education and would, therefore, prefer "change in lifetime income" to measure output. A scholar may, on the other hand, wish to measure disciplinism or growth of the mind and, therefore, prefer "change in percentage intending to attend graduate school" or "change in IQ." The point is that the model must be flexible so that users with different purposes and with different values can employ it for their own purposes. Each goal must be measurable by several means.

The challenge is to identify measures that meet all criteria, for as a rule consensus measures are not quantitative and additive, and quantifiable goals are not generally accepted. Pragmatically, achieving all characteristics 100 per cent is impossible. Compromise is essential.

The realistic choice is between "no measures" (subjective judgments) and "imperfect proxies." Criticism that the measures used are not perfect isn't relevant. If the proxies operationally assist resource allocation, if decision-making is better with the proxies than without, this alone is justification for their adoption. Not to use a proxy because it reflects only imperfectly a desired output is to wait stagnantly for El Dorado.

Proxy measures may be grouped as "input," "output," or "value added." One estimate of the quality of an education is the number of courses offered, the education of the teachers, the breadth of course offerings, the dollars spent per student, and the number of volumes in the college's library. The rationale for these *input* proxies is the very weak assumption that availability and exposure automatically result in learning. *Output* estimates (e. g., number of earned credits, Graduate Record Examination Scores, percentage going to graduate school, average starting salary of graduates) rest upon a similarly weak assumption that all growth measured at the end of college is the result of college or, alternately, that all students enter college with the same background and same potential to learn.

By far the most meaningful proxies measure *changes* or *value added* during the college years. For example, if a student reads 230 words per minute when entering college and 345 when leaving, that the rate increased by 115 words or 50 per cent tells more about the effect of education than either the 230 start figure or the 345 finish. It might be, for example, that some students would start at 400 and drop to 345. Value-added measures will not always be available but they should be used where possible. The greatest problem in developing an omnibus measure of educational output is additivity. Apples and oranges don't add, nor do "increases in income potential" and "changes in percentage of students going on to graduate school." To meet the special need for additivity, the Index Number is proposed as the basic measurement concept.

The Consumer Price Index is an artificial measure of price level *change*, a measure based upon the rather arbitrary assignment of weights to bought goods. Similarly artificial are the Dow-Jones Market Index and job-rating scales.

The time is ripe to unleash index makers on higher education. Some courageous fool whose future doesn't rest upon his reputation as an index maker must go first, so here goes.

Assume that—

M_i = the "ith" measure of output

W_i = the weight assigned to the "ith" measure

M_i^a = value of the "ith" measure at time "a."

w_i = 1,000 (that is, the sum of the weights equals 1,000)

$$W_1 \frac{M_1^a}{M_1^a} + W_2 \frac{M_2^a}{M_2^a} + \cdots + W_n \frac{M_n^a}{M_n^a} = O^a = 1{,}000$$

$$W_1 \frac{M_1^b}{M_1^a} + W_2 \frac{M_2^b}{M_2^a} + \cdots + W_n \frac{M_n^b}{M^a} = O^b$$

A simplistic example, with hypothetical measurement values, will clarify the workings of the model.

MEASURES	May 1969	May 1970	WEIGHTS
Number of degrees granted	7,000 (M_1^a)	7,200 (M_1^b)	300 (W_1)
Starting salaries of graduates	$10,000 ($M_2^a$)	$9,000 ($M_2^b$)	100 (W_2)
Per cent of students rating education as good/excellent	76.3% (M_3^a)	80.0% (M_3^b)	600 (W_3)

$$O^a = 300\,\frac{7{,}200}{7{,}200} + 100\,\frac{10{,}000}{10{,}000} + 600\,\frac{763}{763} = 1{,}000$$

$$O^b = 300\,\frac{7{,}200}{7{,}200} + 100\,\frac{9{,}000}{10{,}000} + 600\,\frac{800}{763} = ?$$

$$O^b = 300 \times 1.029 + 100 \times .90 + 600 \times 1.049 = ?$$

$$O^b = 308.7 + 90.0 + 629.4 = 1028.1$$

1028.1 means that output is 2.81 per cent higher in 1970 than in 1969. Here, three measures were used; the number might as well be 30 or 300. Here a 12-month interval is assumed; the interval might be five years, six months, or one week. Here, the values imply one university. With corresponding magnitudes the unit might be the state, the region, the nation, or a college, a department, a course, or a portion of a course. 2.81 per cent is all it means. Of course, 1028 cannot be priced in dollars (unless someone even more a fool than I should price 1,000). Thus our measures provide a yardstick for *change in output* only.

Again, job rating systems are analogous. Here jobs are assigned point values that make sense only when related to one another. The dollar valuing of points is an independent process.

Admittedly, a dollar figure for output would be superior to a measure of percentage change. But a percentage change measure is a gigantic step forward, a step that has value by itself and a step toward the ultimate goal of a benefit measure that is in the same units as costs.

First Attempt

So, realizing the limitations, let's proceed to a more complicated and plausible model. To identify appropriate measures we ask, "What is the least imperfect quantitative measure of Objective #1? Of Objective #2?" Answers are provided in Table 1.

Throughout Table 1 appears "student testimony" and "faculty testimony." By this is meant direct feedback by students on whether they think they're learning and by faculty on whether they think they're stimulating, producing, and/or enjoying. Trust in such measures involves a basic faith in human nature and self-analysis. It is the confidence that customers are valid judges of the quality of merchandise they purchase, that professors can judge the effectiveness of a lecture, that students can accurately rate teaching effectiveness, etc. It is the confidence that when quantitative objective data are not available we are better served by a subjective qualitative measure (couched in quantitative terms) than by no measure at all.

Obviously, the collection of these testimonies will require administering opinionnaires to the target groups periodically. Facsimile questions for such opinionnaires are cited in the table as examples only. Wording must be detailed by others with more expertise.

TABLE 1. MEASURES FOR EDUCATIONAL GOALS

GOAL OR OBJECTIVE	SUGGESTED MEASURE(S)
A. Learn to Feel	1. Student Testimony* (e.g., student's answer to question, "Has college increased your sensitivity to the problems of others and your appreciation for classical music by: 'a great deal,' 'a modest amount,' 'not at all,' or 'decreased'?")
B. Learn to Retain Facts	2. Student Testimony* (e.g., "While in college has your factual knowledge: 'more than doubled,' 'increased some,' 'remained about the same,' or 'decreased'?")
	3. Difference between percentile rank on GRE (or substitute exam) and percentile rank on SAT or ACT.
	4. Difference between "before" and "after" reading-listening test on totally new material.
C. Learn to Think	5. Student Testimony* (e.g., "While in college your logic and reasoning abilities have: 'more than doubled,' 'increased some,' 'remained about the same,' or 'decreased'?")
	6. Difference between "before" and "after" score on Miller Analogy Test.
D. Learn to Decide	7. Student Testimony* (e.g., "While in college your ability to choose alternatives, to reject some life styles, and to choose wisely: 'more than doubled,' 'increased some,' 'remained about the same,' or 'decreased'?")
	8. Difference between "before" and "after" item analysis of College Student Questionnaire.
E. Learn to Act	9. Student Testimony* (e.g., "While in college has your effectiveness in communicating ideas to others: 'more than doubled,' 'increased some,' 'remained about the same,' or 'decreased'?")
F. Learn to Learn	10. Student Testimony* (e.g., "While in college have you increased your ability and your motivation to learn on your own, to be a self-starter by: 'a great deal,' 'a modest amount,' 'not at all,' or 'decreased'?")

	11. Difference between "before" and "after" item analysis of College Student Questionnaire on questions such as, "How many books did you voluntarily read in the last six months?"
	12. Difference between "before" and "after" score on an artificial language test.
G. Choose a Career	13. Student Testimony* (e.g., "In *selecting* a career, attending college helped: 'a great deal,' 'a modest amount,' 'not at all,' or 'negative influence'?")
	14. Per cent of students who identified or altered specific career goal while in college, as measured by "before" and "after" samplings.
H. Gain Admission to Next Stage in Career	15. Student Testimony* (e.g., "Did college move you along toward your career goal: 'a great deal,' 'a modest amount,' 'not at all' or 'negative influence'?")
	16. Change in per cent declaring graduate school (or medical or law schools) intention "before" and "after."
I. Develop Skills of One's Chosen Profession	17. Student Testimony* (e.g., "While in college your proficiency in the skills of your chosen profession: 'more than doubled,' 'increased some,' 'remained about the same,' or 'decreased'?")
	18. Difference between "before" and "after" percentage of students passing specific professional examinations such as the Bar Exam or the CPA Exam.
	19. Number of pages published by graduate school graduates in scholarly journals.
	20. Difference between Cartter rating of school of undergraduate enrollment and of first job (applicable to graduate students only).
J. Earn a Living	21. Student Testimony* (e.g., "While in college my ability to earn an acceptable living: 'more than doubled,' 'increased some,' 'remained about the same,' or 'decreased'?")
	22. Ratio of starting salary of age cohort of college graduates versus matched pair (by ability and background) of persons who did not attend college.
K. Fulfill Society's Manpower Needs	23. Student Testimony* (e.g., "While in college my ability meaningfully to contribute to the manpower needs of the nation and

	society increased by: 'a great deal,' 'a modest amount,' 'not at all,' or 'decreased'?")
L. Identify New Phenomena	24. Faculty Testimony* (e.g., "During last year your most significant discovery will desirably alter the course of history: 'a great deal,' 'a modest amount,' 'not at all,' or 'in a negative way'?")
	25. Number of dollars received from new patents.
M. Synthesize and Summarize in New Ways	26. Faculty Testimony* (e.g., "During last year did your research and study result in a new synthesis or summary that will desirably alter the course of history: 'a great deal,' 'a modest amount,' 'not at all,' or 'in a negative way'?")
N. Communicate New Knowledge	27. Faculty Testimony* (e.g., "Your thinking and writing during the last year has stimulated professional colleagues: 'a great deal, 'a modest amount,' 'not at all,' or 'negatively'?")
	28. Number of pages published in scholarly journals and books during the last year.
O. Relate Knowledge to Societal Problems	29. Faculty Testimony* (e.g., "During the last year personal consultation assisted in the solution of important societal problems: 'a great deal,' 'a modest amount,' 'not at all,' or 'a negative effect'?")
	30. Number of days spent consulting (paid and unpaid) last year.
P. Carry Out Societal Project	31. Faculty Testimony* (e.g., "During the last year my hours devoted to implementing a society-aiding project contributed to the success of that project: 'a great deal,' 'a modest amount,' 'not at all,' or 'negatively'?")
	32. Number "graduated" from funded training programs.
Q. Evaluate Effectiveness of Current Attacks on Problems	33. Faculty Testimony* (e.g., "During the last year my role in evaluating the effectiveness of various projects designed to better society was: 'a great deal,' 'a modest amount,' 'not at all,' or 'negative'?")
R. Increase Dignity and Self-esteem of Faculty	34. Faculty Testimony* (e.g., "During the past year my image of myself and my colleagues has grown: 'a great deal,' 'a modest amount,' 'not at all,' or 'decreased'?")

	35. Percentage change in compensation divided by percentage change in income for entire U. S.
S. Increase Student Enjoyment While in College	36. Student Testimony* (e.g., "While in college you had: 'a great time,' 'a good time,' 'little or no enjoyment,' or 'a miserable time'?")
	37. Per cent intending to donate after college "before enrolling" versus per cent intending to donate (or donating) "after graduating."
T. Provide Benefits to Town Citizens	38. Faculty Testimony* (e.g., "During the past year town residents not directly associated with the university benefited from the university's presence: 'a great deal,' 'a modest amount,' 'not at all,' or 'negatively'?")
	39. Change in number of part-time students enrolled.
	40. Change in number of public lectures and performances given.

*Student (faculty) testimony might include not only the assessment of self-growth but also the growth of the student's (faculty's) best friend. Thus, an alternate to the question at measure one might be "Has college increased your best friend's sensitivity . . . ?"

Forty measures are listed as examples. More can and should be added to the laundry list. Then, each group using the model should pick and choose the measures appropriate to its need and bias. A group of faculty may wish, for example, to weight Measure 35 (change in faculty salaries) very heavily and to assign zero weight to Measure 39, either because it is unavailable or thought to be unreliable. In a different way a group of legislators may wish to weight Measure 25 very heavily and to assign zero weight to Measure 19. The beauty of the model is its flexibility. It expands and contracts according to the availability of data and its reliability. It changes emphasis according to the perspective and purpose of the user. It allows the ordinal measurement of changes for any time period and for the most micro as well as the macro of units.

To highlight some of the differences in perspective on output, in Table 2 I venture the dangerous game of speculation, speculation about the weights that would probably be assigned to the various objectives, and then to the measures by the four interest groups in our conference matrix. The weights assigned to the objectives are "the ideal set." The weights assigned to the measures are "the ideal set tempered by differing confidence in the measures available." For example, by faculty the Objective, "learn to feel," is weighted ten but the Measure 1 is weighted only five. This means that faculty have less confidence in the ability to measure "learn to feel"-type output than in measures of other types of output.

Generally, the faculty is characterized as placing greater value on long-range objectives, on professional-disciplinary objectives, on personal remuneration and satisfaction, and on its own testimony. Students emphasize professional-skill goals and evidence great confidence in their own testimony. Legislators emphasize hard measures and outputs that increase the gross national product. Private citizens mix the objectives and biases of the three other groups.

Table 2. Estimated Weights Assigned Educational Goals and Their Measures

Weights Assigned Objectives by—				Objectives	Measures of Objectives	Weights Assigned Measures by—			
						Faculty	Students	Public	Private
Faculty	Students	Public	Private						
10	40	10	10	Learn to Feel	1. Student Testimony	5	40	5	5
30	60	25	50	Learn to Retain Facts	2. Student Testimony	80	75	80	90
					3. ACT-SAT vs. GRE				
					4. Read-Listen Test				
100	80	50	70	Learn to Think	5. Student Testimony	80	80	50	50
					6. Miller Analogy				
30	100	80	50	Learn to Decide	7. Student Testimony	15	90	10	25
					8. College Student Questionnaire				
30	80	80	90	Learn to Act	9. Student Testimony	10	80	60	60
100	80	30	30	Learn to Learn	10. Student Testimony	60	75	20	20
					11. College Student Questionnaire				
					12. Artificial Language Test				
300	440	275	300		**SUBTOTALS FOR ITEMS 1-12**	250	440	225	250
20	80	30	80	Choose a Career	13. Student Testimony	10	50	10	20
					14. Per Cent with Career Goal	20	20	20	60
30	80	20	60	Move to Next Stage	15. Student Testimony	10	50	10	20
					16. Per Cent Graduate School	40	40	30	50
200	80	120	120	Develop Skills	17. Student Testimony	50	60	50	50
					18. Specialized Exams	150	60	130	130
					19. Pages Published*	0	0		
					20. Cartter Ratings*	0	0		
40	90	80	120	Earn a Living	21. Student Testimony	30	60	40	40
					22. Starting Salary	20	50	70	85
35	30	150	95	Fulfill Manpower Needs	23. Student Testimony	20	20	100	80
325	360	400	475		**SUBTOTALS FOR ITEMS 13-23**	350	410	460	515

*Applicable only to graduate students.

Weights Assigned Goals by—				Goals	Measurement of Goals	Weights Assigned Measures by—			
Faculty	Students	Public	Private			Faculty	Students	Public	Private
75	20	25	25	Discover New	24. Faculty Testimony	25	5	10	10
					25. $ New Patents	25	5	30	20
25	10	25	25	Synthesize New	26. Faculty Testimony	20	5	15	15
50	20	25	25	Communicate New	27. Faculty Testimony	20	5	10	10
					28. Pages Published	35	10	10	20
150	**50**	**75**	**75**		**SUBTOTALS FOR ITEMS 24-28**	**125**	**30**	**75**	**75**
15	15	75	50	Relate New	29. Faculty Testimony	5	5	30	20
					30. Days Consulting	10	10	60	40
5	20	75	20	Carry Out Project	31. Faculty Testimony	5	5	10	5
					32. Training Programs	0	5	35	15
5	15	50	30	Evaluate Project	33. Faculty Testimony	5	5	35	20
25	**50**	**200**	**100**		**SUBTOTALS FOR ITEMS 29-33**	**25**	**30**	**170**	**100**
150	20	10	10	Dignify Faculty	34. Faculty Testimony	100	10	5	5
					35. Faculty Compensation	100	10	20	10
30	70	15	25	Delight Students	36. Student Testimony	20	55	10	20
					37. Per Cent Giving	10	5	5	5
20	10	25	15	Benefit Townies	38. Faculty Testimony	10	5	5	5
					39. Part-time Enrollment	5	5	20	5
					40. Number of Lectures	5	0	5	10
200	**100**	**50**	**50**		**SUBTOTALS FOR ITEMS 34-40**	**250**	**90**	**70**	**60**
1000	**1000**	**1000**	**1000**		**GRAND TOTAL**	**1000**	**1000**	**1000**	**1000**

The figures here are only guesstimates. The model is not ideal but it is a start. A department chairman may begin evaluating output immediately by applying a simple four-variable model to his graduating seniors. He could arbitrarily weight the four variables or, better, seek the consensus of his department. Possible weights might be:

Measure 3, ACT-SAT vs GRE.....	300
Measure 5, student testimony.....	400
Measure 16, % grad school.....	200
Measure 28, pages published.....	100
Total	1000

Each year, more data and more experience with each measure will stimulate adjustments in the model. By try and cut, a workable model evolves.

Similarly, a legislative review committee or a citizens' group may structure a model unique to its needs and biases. If, at first, the data desired are unavailable, "next best" measures can be inserted until the preferred data are available. The group might, for example, initiate a model with only two measures (say Measure 18, specialized exams; and Measure 22, starting salaries). In the second generation model, Measure 18 might be discarded and Measure 17 plus Measure 2 added.

Accrediting teams, visiting examiners from governing boards, legislative review commissioners, and other evaluators may ask an institution (e. g., a university) or a group of institutions (e. g., a university system, a mental health system, a highway system) to choose its own measures, use its own weights, and submit an evaluation of progress.

The value of this approach is its flexibility and the fact that it may be implemented immediately.

I am proposing a let's-get-started-now scheme for evaluation. The scheme is far from ideal. It will be applied differently by different groups; it measures only change in output and not absolute worth; it relies on untested measures — but it is a start! There are compelling reasons for higher education to start evaluating output, even if it must be by try and cut.

The proposed evaluation scheme is based on Diagram 1.

Educational outputs (see Diagram 2) are both the appreciation of human capital (whole man, pool of knowledge, specialized man) and immediate enjoyment (public service, joy of producing). The total contribution of higher education is the sum of these outputs, as shown by the Equations.

Stimulating the growth of incoming students are three basic environmental forces (Diagram 3):

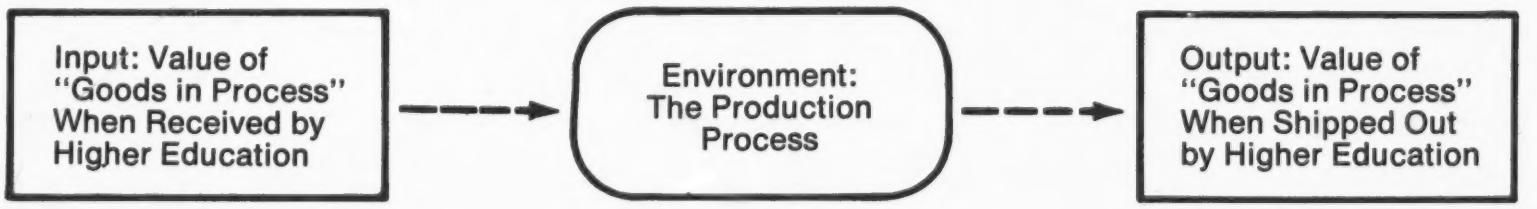
(1) Human resources: for example, size and quality of faculty, size and quality of secretarial help, size and quality of administrators, size and quality of student body.

(2) Physical resources: for example, buildings, educational media system, computer, library, location relative to other colleges and a central city.

(3) Tactics and Methods (of relating resources to input): for example, organization of curriculum, governance structure, teaching methods.

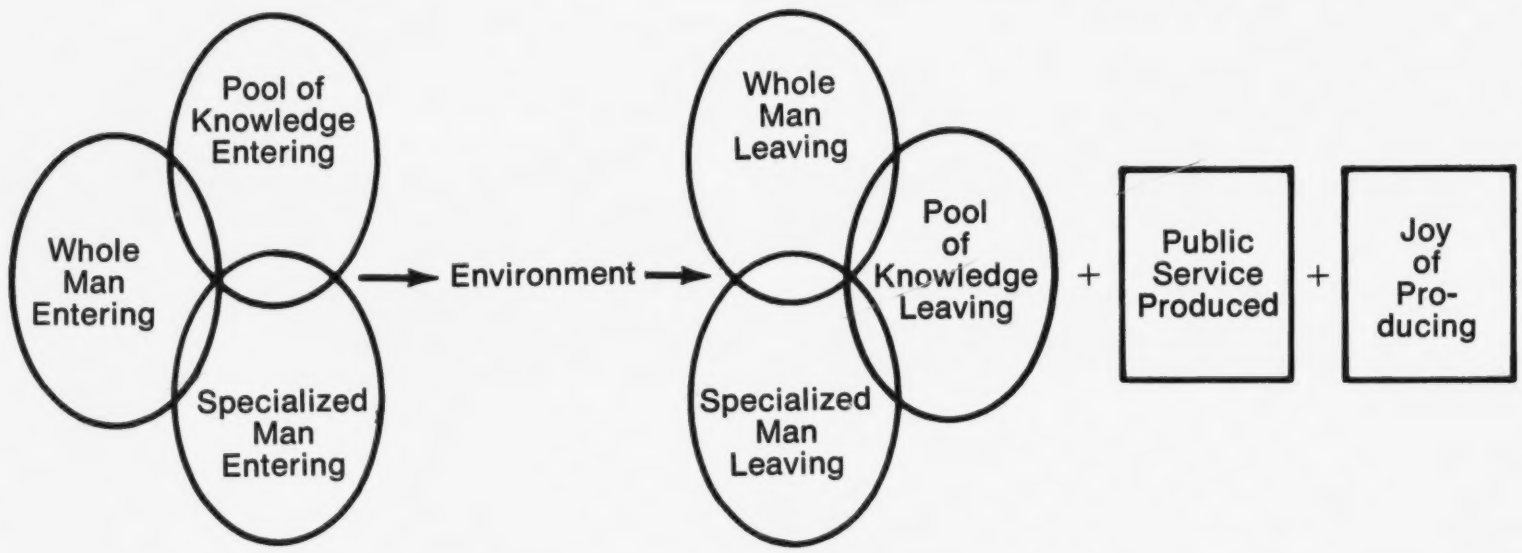
To evaluate higher education's successes, measured output must be contrasted to the cost of providing the environment. Environment is created by committing resources; the measurement of this commitment is relatively simple. Historically, the problem has been measuring the evaluating output. This paper proposes a scheme to solve that problem.

DIAGRAM 1. THE SIMPLE MODEL


Input: Value of "Goods in Process" When Received by Higher Education
Environment: The Production Process
Output: Value of "Goods in Process" When Shipped Out by Higher Education

Input passes through the environment to become output. The objective of higher education is to add value to the input (students), as it passes through the environment (college).

DIAGRAM 2. THE BASIC MODEL

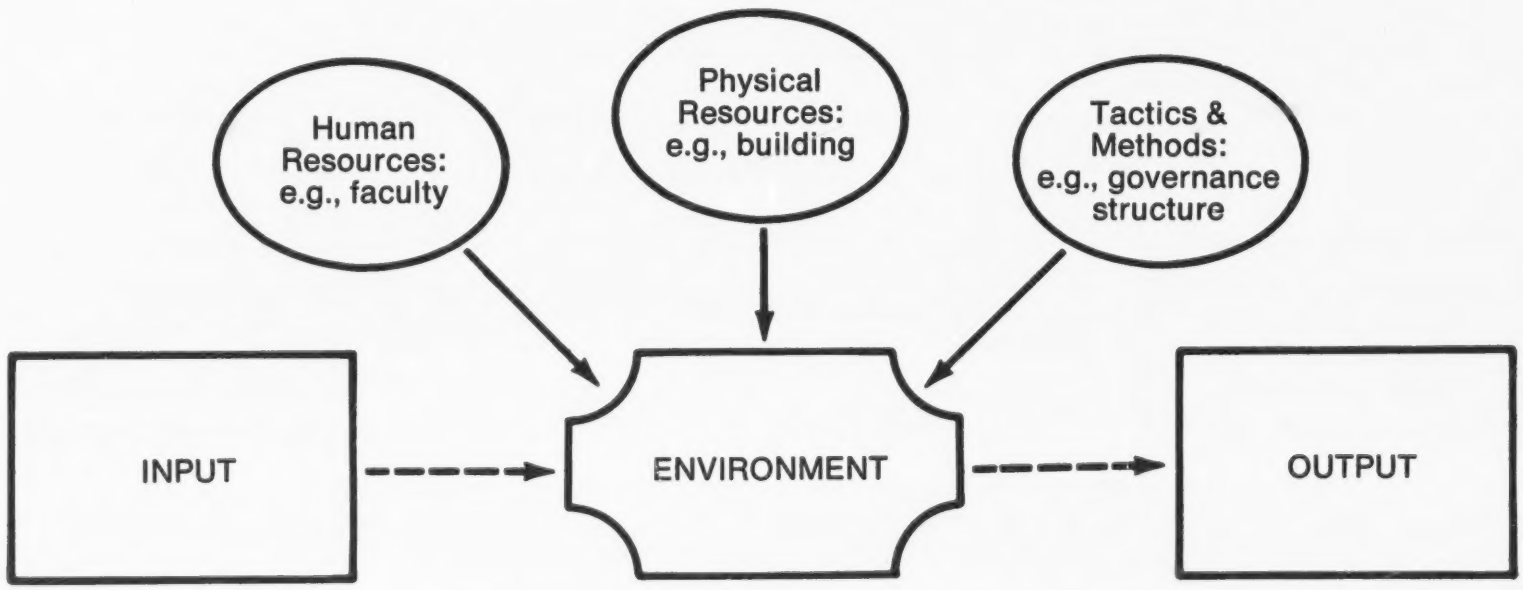


EQUATIONS:

$$\text{Net Value of Output} = \text{Gross Value of Output} - \text{Gross Value of Input}$$

$$\text{Net Value of Output} = \text{Growth in Whole Man} + \text{Growth in Specialized Man} + \text{Growth in Pool of Knowledge} + \text{Public Service Produced} + \text{Joy of Production}$$

DIAGRAM 3. COMPONENTS OF ENVIRONMENT



C. West Churchman

is Professor of Business Administration at the University of California, Berkeley, and also Associate Director of the Space Sciences Laboratory. He received his Ph.D. from the University of Pennsylvania and has taught philosophy at both the University of Pennsylvania and at Wayne State University, Detroit.

Widely known for his publications in the management field, he is presently chairman of the editorial council for the journal, *Management Science,* and editor for both *Management Science* and *Philosophy of Science.* In addition to his academic and administrative experience, he has had extensive practical experience with industry, defense, health, information processing, and city government.

He is currently head of a project at the University of California, studying the management of research in industry and government.

"I have a feeling... that many high school students look on college as continuing the most unsatisfactory aspects of their high school experience, while at the same time providing no qualitative change in their lives."

"By what means can we educate ourselves about the best method of education without having presupposed the answer to the very question we are asking?"

"We should examine the cost of the implied change of the educational process from an emphasis on the transmittal of knowledge to an emphasis on the maturation of the inquiring mind... It is obviously premature to say whether the growing need for opening up inquiry really constitutes a major revolution in the institutional system."

"If it is true that most Ph.D.'s do not do research after receiving their degrees, then surely the output of Ph.D. programs is poor. I believe that most of our graduate programs... simply tend to produce people whose continued interest in inquiry has been killed off in the process of the program."

R^2 on E: Some Suggestions for Research on the Role of Research in Higher Education

C. WEST CHURCHMAN

The purpose of this paper is to discuss the role of research in the educational process, especially at the higher educational level, but not necessarily restricted to this area of education. My main effort will be to try to suggest some areas where educational research on the research process could be quite helpful to the future of higher education.

I need to begin this discussion with a number of apologies and explanations.

Determination of Goals Emphasized

First, I realize that I've probably been asked to deliver this paper because I've written on the "systems approach." The paper, however, emphasizes one aspect of this approach, namely, the determination of the goals of the educational system and not the efficient ordering of components and resources to attain given goals. In other words, I have a strong bias in the subject of educational planning toward a continuing re-examination of our educational goals. I realize that the attempt to define the goals of education was at one time very popular and has since entered into a period of disillusionment as we discovered how difficult it is to define these educational goals in a manner which would make any difference in the educational process. I think the disillusionment itself was mistaken, just as a disillusionment in the attempt to define national goals would be a mistake. Obviously, an area so rich and difficult as the definition of human goals demands, like any life form, a growth through immaturity to some kind of mature status; and the maturation period may be very long, indeed, as I am convinced it will be in the case of educational goals. Simply to be disappointed because in a relatively short period of time we have not been able to reach a reasonable consensus on educational goals is certainly no reason to give up the enterprise.

Second, I need to say some things about the "outputs" of higher education in the context of goal-setting. As will be seen in the second part of this paper, I'm convinced that there is a task of reflection that needs to be undertaken before we can feel satisfied with any specific proposals for outputs. Part of this task consists of trying to decide whether we should regard the primary output to be the transfer of knowledge, or rather the maturation of each individual's style of inquiry. I think we get radically different analyses of systems of higher learning depending on how we respond to this issue.

Third, it should be pointed out that the paper really concerns itself with research at three different levels:

(1) There is the research carried on by the student, and the relationship of this research to his other educational and social activities.

(2) There is the research undertaken by the educational researchers who are trying to examine some issue in the connection between the role of the student's research and his educational goals.

(3) There is the research of this paper itself, which, as I have pointed out, is somewhat limited with respect to background literature materials. It is also strongly biased by my own research preferences at the present time and, namely, the use of research to study large social systems. This bias means that a good deal of what I will have to say will not be restricted to the research process itself, either at the student level or at the educational research level, but to the relationship of this process to other kinds of activities occurring in society.

Concept of Research Explained

I must also express a bias regarding the concept of research. This can best be explained by a very broad definition of research, namely, that research is a set of human activities where the activities are intended to produce knowledge and, in particular, a knowledge of a more effective means of accomplishing socially desirable ends. You will note that in this definition I have made no reference to such things as control of variables, statistical inference, and the like, because I regard these to be possible tactics and strategies of the individual whose intent is to acquire knowledge. These strategies may, in fact, not be desirable in many contexts. They are, of course, highly desirable when it's possible to conduct the research within experimentally

controlled situations, and when there is an exclusive desire to learn exactly what elements of nature cause other elements to behave in a certain manner.

My bias is that I believe that educational research and, in particular, educational evaluation makes a mistake if it attempts to wed itself rigidly to the strategy of precision and control. There's an immense amount of knowledge acquired by a human being without the use of carefully controlled experiments. Take for example, the process of learning how to drive an automobile, which, for each individual and within that context, falls under my definition of research. It could scarcely be said that the learner carefully controls the variables associated with his hands, feet, and eyes, and learns which particular motions cause various events to occur in maneuvering an automobile. There's much to be said on the benefit side for carefully controlled experiments, but there is also the cost of rigor to consider. In the terms of the systems scientist, we require a "cost-benefit" analysis of our research strategies. In order to keep educational evaluative research from becoming unnecessarily trivial, it may be necessary to give up some of the traditional concepts of control. At the same time, of course, I'm not saying that loosely designed research is good in and of itself. What obviously is required in the field of educational research is some research aimed at trying to evaluate strategies and tactics for various kinds of problems. For example, we need to know a great deal more about the circumstances under which carefully controlled experiments have a positive net value in the educational process. We also need to learn a great deal more about the conditions under which simulation, e.g., on computers, is a useful way of learning about the educational process.

Consequently, the first area of research I would recommend for study is a "systems approach" to educational research, i.e., an examination of the tactics and strategies of such research systems and a systematic way of trying to evaluate where these strategies and tactics seem best and where they become less than adequate.

Research by the Student

With these apologies and suggestions behind us, suppose now we turn to the first level of research, namely, the research carried on by the student in higher education. We can begin by ruling out considerations of certain aspects of research in the student's life. I don't doubt that the role of research in graduate education, especially at the Ph.D. level, is well established within many disciplines. It is not apt to change radically in the coming years. I think it is a plausible hypothesis that in many disciplines, especially in the physical sciences, the role of research in the student's program is well embedded within the policies of the particular discipline. To be sure, there may be a number of questions that one would want to ask about specific policies of institutions with respect to the rigidity of course requirements, the preclusion of the student from research programs until much too late in his curriculum, and so on. In this paper, however, I'm not addressing myself to the problem of the role of research within well established graduate curricula.

There are two areas which I would like to examine. One is the rather specific role that research might play in the teaching process within higher education. The second is concerned with the overall goals of the educational process and specifically with the contrast between "knowledge transfer" and "maturation of an inquiring style."

Turning to the first of these, it is perhaps useful to review the debate that has been waged about the relationship between teaching and research in institutions of higher learning.

The traditional approach can be rather easily stated. It argues that one of the principal tasks of most institutions of higher learning, especially at the undergraduate level, is to provide education to a large number of students as economically as possible. The argument stipulates that the only means of accomplishing this goal is the traditional method of teaching in classrooms either to a large number of students who are subsequently broken up into quiz sections or to a large number of sections, many of which are run by young teaching assistants. Research, the argument goes on, demands individual attention because every research project is highly specific; if the research is to be performed in an adequate manner, the younger student requires very careful supervision on the part of someone knowledgeable in the field, e.g., an associate or full professor. It is not feasible, therefore, to expect that a large number of students can be taught by means of an expanded research program in which undergraduates are involved actively in doing a significant amount of research. Furthermore, research is highly specific, because it must deal with a very concrete aspect of the natural world. But the purpose of much of undergraduate education is to provide the student with as broad and general an educational base as possible. Of course, research should be an integral part of the curricula when the student is being prepared for a

life as a scientist or an engineer, i.e., in professions where research itself plays an integral role. But for the general student a significant concentration on research deprives him of the kind of broad education which our undergraduate programs are supposed to provide. Finally, the argument concludes by pointing out the other deficiency of research, namely, that it is in conflict with the teaching program in terms of faculty time. The argument stipulates that faculty are rewarded for their research output, especially in large universities, and that this reward system in effect requires that the faculty concentrate on their research efforts to the neglect of hours that might be spent in direct contact with undergraduates.

Research As Teaching Method

The other side of the argument can best be expressed in its strongest form in the terms of one of my earlier teachers, Professor Henry Bradford Smith, who was a strong proponent of the use of research as a teaching method. According to Smith, the ideal college would be one in which the undergraduate from the beginning works with a professor in developing a research project which will occupy his attention during his four years. As a result of the design of a specific research project, according to Smith's concept, the undergraduate is led naturally into all the ramifications connected with his research. He will sense the requirement to write well and even dramatically, to understand the historical background of his research effort, to delve, if necessary, rather deeply into the mathematical and statistical methodologies required to bring his research to fruition. In other words, he will attain an understanding of the relationship of his own research program to the larger system. In such a way, thought Smith, the student would be led to the kinds of "general education" which has been so strongly advocated in past decades. But instead of being fed general education in a piecemeal fashion, his education would become meaningful and relevant to him. As a historical point, I might say that Smith's concepts of educational relevance were stated some forty years ago. The notion that a great deal of so-called general education is irrelevant is by no means news to many of the teaching community.

We can see that the issues involved in the debate are by no means so specific that one could conduct a test that would once and for all settle the matter. This situation is quite characteristic of the major issues that concern any large scale social system. Immanuel Kant in his *Fundamental Principles of the Metaphysics of Morals* states the matter superbly. In his discussion of what he calls the prudential imperative, which today we would translate into the concept of policy, Kant argues that the basic issues cannot be settled in any final way because our knowledge depends on specific empirical tests; whereas the settlement of basic issues involves the total system of a person's life or many persons' lives.

Kant's point is well taken in connection with the issue we are now discussing. The question is: What policy should be followed in undergraduate education *vis-à-vis* research and teaching? Undergraduate education is only a part of the total life of the individual; although it is probably accurate to say that in many cases the four years of undergraduate life have tended to be rather decoupled from the rest of the individual's life, e.g., his high school education and subsequent career after graduation from college. This does not mean that research has no role in clarifying the issues. It simply implies that research by itself cannot ever settle the debate. The role that research will play in the present discussion is to identify one or more of its weakest elements of the world view of each side.

In this case, as I see it, one of the chief weaknesses of the traditional world view of the undergraduate educational process is its claim that the traditional method of teaching a student in a classroom is the most effective way of handling student education. This position seems especially weak in the case of what might be called the methodological sciences, i.e., statistics, mathematics, logic, etc. The methodological sciences should also include English composition and what used to be called rhetoric, i.e., the ability to express oneself clearly in the spoken word, and, perhaps, other disciplines like foreign languages and even historical methodology.

The kind of research I have in mind would entail a study of the extent to which a student learns his methodology in the context of research, compared to his learning in the more traditional classroom situation. And in this connection I should make it clear that when I use the term, "student research," in this context, I'm thinking of a student who's studying a real-life problem, say, a problem of the planning of an organization such as a university library or a health center or a business firm. To make the point clear, it is helpful to distinguish between the "exercise" and the "problem." Exercises that are found at the end of texts in statistics, operations research, etc., almost always provide the student with an opportunity to "apply" what he has learned in a given

chapter; but they may not be helping him develop his methodological capabilities in real-life situations. Exercises at the end of chapters can be described as tasks where the basic data and system constraints are given by an external authority, in this case, the textbook or the teacher. In the real-life situation, such basic information and constraints have no clear authorities. The student learns that there are differences of opinion within the organization as to what things are relevant or what constraints should be placed on a problem. Indeed, many students who have received a thorough training in the methodologies, when faced with problems in real-life organizations, often feel extremely frustrated because there is a lack of authority. My point can be well illustrated by a recent textbook in management science by Harvey Wagner called *Management Science: Applications*. What one finds in Professor Wagner's book is a series of exercises in which the student is provided all of the basic elements of a solution. It may be a disservice to the methodology itself to claim that such exercises will prepare the student for "applications."

Which Input Produces Best Results

Thus, in the educational research I have in mind, an attempt would be made to determine whether a student learns better how to use statistics, mathematics, English writing, etc., outside the classroom preparation within the context of a real-life research problem; or whether a certain amount of formal teaching and real application is better; or whether the entire subject matter can be learned within the classroom. Phrased in terms of output, the question is whether an input of classroom hours or an input of research activity produces more ability to solve the social problem as judged, say, by a group of experts, or the student himself.

It goes without saying that the research I have in mind would be done with psychological correlates in mind. Obviously, some people do have a capability of storing a vast amount of information about techniques, and it may very well be true that such persons can learn just as well or even better in the classroom exposure than they would within the real-life research. It also goes without saying that a "control group" should be included in such an experiment, where the student is essentially self-learning, i.e., studies out of the text on his own with minimal consultation with a teacher.

A great weakness in the position that research is the best way to learn is the assumption that this method can be used with a large number of students and a relatively few number of faculty members. In other words, it looks as though a much greater input of teacher-hours is required to implement the learning-by-research plan, perhaps a totally unmanageable amount of input. The research position naturally has to argue that the present method of organizing a faculty member's time is incorrect. It's clear that the professor's main effort should be to attain a face-to-face contact with the student in directing him into bodies of information, methods, etc., which will help him to accomplish his research mission. This means that the teacher's student-classroom exposure hours would be reduced to a minimum. The position can hardly hold that no classroom teaching is to be permitted. Evidently a number of students could gather together to study a certain phase of a problem where, say, statistical methods are essential. In such an event, the traditional classroom technique seems obviously the correct one to follow. What the position must try to explore is the extent to which students can be their own educators, i.e., the extent to which one student can be successfully used to teach another or where a student can engage in his own self-teaching. The concept is well expressed in Russell Ackoff's paper on the "new university" in which he discusses the educational organizations broken up into "self-teaching centers."

There is another aspect of this problem which needs to be investigated. If we were to attempt to change institutions of higher learning into self-teaching institutions, then obviously there would be a number of political pressures imposed by both administrators and faculty to prevent this step, which in a way looks like a relinquishment of the faculty's prime responsibility. This is the problem of implementation which plagues all planners and systems scientists. It is the implementation problem in its very strongest form, since the policies being considered are those which appear to strike at the very heart of the traditional way of running the academic institution. What seems really called for in this connection are some educational inventions which on the one hand preserve the faculty's traditional role of freedom and educational leadership, but at the same time provide a kind of flexibility in which the student can enter into a teaching relationship with other students.

The Search for Breadth and Depth

I'd like to turn now to the second topic of my presentation, which concerns itself with the type of research which the student might carry on which

would provide the kind of educational breadth and depth that is so desperately needed. I'd like to return to some remarks that were made earlier about the relationship of the college to the other aspects of an individual's life, i.e., the linkages between the college part of his life and his high school and subsequent career. I have a feeling, unsupported by any large amount of information at my disposal, that many high school students look on college as continuing the most unsatisfactory aspects of their high school experience, while at the same time providing no qualitative change in their lives. Part of this feeling undoubtedly arises because of the ill-stated goals of colleges with respect to their educational programs.

The one common conception of the goal of a college can be described in terms of a model of the educational process in which the educational institution acts as a transferer of knowledge from books or from individuals to the student. This knowledge, of course, is not just restricted to facts, but involves conceptual knowledge of the ways in which people should think about issues in a rational manner, appreciate their environment, the arts, and so on. The essential idea, however, is based on the transfer concept, so that the faculty as well as the library play the role of the storehouse of human knowledge; and the student plays the role of the recipient of this knowledge. The aim, then, is to produce an individual who is knowledgeable in the sense that he can respond, say in a conversation, to issues familiar to his peers.

In the remainder of this paper, I would like to discuss an alternative objective and its corresponding model for the institution of higher learning. This objective of the college is based on the model which says that the purpose of the college, as well as other educational institutions in an individual's life, is to create a "mood for inquiry." According to the model, this mood of inquiry must fit into the individual's personality and life style, i.e., to his psychological being. Consequently, the emphasis is more on the activity of inquiry, as it becomes meaningful to the individual, than it is on any specific informational content that he should receive according to certain prescribed educational standards. Also, the purpose is not to transfer knowledge *per se*, because now knowledge becomes only a means of inquiry. Rather, the purpose is to create within the individual the motivation toward inquiry, as one of his life functions.

To summarize, the fundamental characteristics of inquiry are the following:

a. the motivation to learn

b. openness to change of fundamental assumptions

c. the development of inquiry as an integral part of the individual's total life style

As I suppose is obvious, it is no easy matter to define these characteristics in terms of some measurable "output"; nor is it clear the input-output analysis would be appropriate for this model. In the transfer-of-knowledge model, on the other hand, input-output analysis seems to be very satisfactory; not only can one measure, in principle, the amount of knowledge transferred, but also the quality and possibly the benefit of the knowledge. In the style-of-inquiry model, the output might be defined, in a longitudinal study, as the person's relative interest in continuing to learn; but how to make such a concept operational is not at all clear. In other words, if one looks at higher education through the spectacles of the second model, one will have to give input-output analysis a careful scrutiny to see if it's the right strategy.

It would, obviously, be impossible in this paper to display all of the different styles of inquiry, especially if one admits that inquiry is an integral part of the *individual's* life and, hence, that the style is virtually unique to each individual. It may be worthwhile, however, to repeat that aspects of inquiry, like consistency, precision, and control, do *not* represent the fundamental characteristics of inquiry. These characteristics, to be sure, have proved extremely useful in certain areas of science and scholarship; but, as I mentioned earlier, they have also tended to narrow the scope of the research and, indeed, in many instances to make it trivial and thoroughly unimportant, as far as either social change or the individual is concerned. It goes without saying in these days of the proliferation of research findings that publication is also *not* a fundamental characteristic of inquiry. There is, of course, the need for certain individuals to communicate with others in the process of inquiry; but it is doubtful whether the particular technology of the printed word really serves as an important characteristic of inquiry for most people.

The model that I am discussing, which is related to what Kant calls a "whole life model," obviously requires the development of an inquiring mind at the earliest possible stage, even in the pre-nursery school, and certainly through grammar and high school. For example, there seems to be no obvious reason why grammar and high school students should not, if they feel so inclined, express a strong interest in the manner in which their school is run, and in the environment of the school.

Maturation of an Inquiring Mind

It would seem reasonable to assume in this model that college, for the person of the years from 17 to 21, becomes essentially the locus of the maturation process of the individual, especially of his inquiring mind. Consequently, the "success" of the college program within this model is essentially to be assessed in terms of whether or not the program seems able to bring the student from prematuration through to the mature individual who has confidence in his own methods of inquiry, the motivation for inquiry, and all of the humility and modesty that go along with the inquiring process.

It's also assumed by this model that the maturation process by no means stops at the end of college. After college comes the life process in which "higher education" needs to play a fundamental role.

If, in this model, it is appropriate to consider "college" as the maturation process, then one "output" of college is the student's satisfactory realization that his mode of learning has matured. Such a student, in effect, would have learned enough about himself to know why he went to college and why he should go no longer. The time span to reach this maturation might be four years or four days or whatever.

Finally, it's assumed that everyone is included in the total process of becoming a mature, inquiring mind. That includes the faculty, who can no longer be regarded as the authorities on curriculum and knowledge transfer. The faculty themselves are in the process of developing their inquiring minds. No amount of depth of inquiry in a particular field necessarily completes the inquiring aspect of the mind.

The model assumes that the direction of inquiry is a matter of individual style and motivation. Although, today, there is a great deal of talk of using inquiry into matters concerned with the community, it is not the intent of the model to claim that such inquiry has superiority over other types of inquiry. It is clear that the human race at the present time knows very little about its communities, both the smaller communities surrounding urban and rural centers of population, and the larger communities of the state, nation, and inter-nation. Our lack of knowledge is well displayed in the fact that we have very little reliable data concerning the impact of social change. We can regard, for example, the poverty program in its early years as essentially a blind man's walk; because the planners knew very little about the conditions of poverty and the reactions of the poor class, as well as reactions of other individuals who might become interested in poverty as a business enterprise.

The lack of good information is well demonstrated in the field of economics, where, although we have become reasonably powerful in certain theoretical concepts, the basic information is missing.

But the direction of inquiry may be into many other areas. Dr. Kilton Stewart has an interesting report on the Senoi of Malaya, a tribe which spends a great deal of its inquiring time with dream material from childhood all the way to death. According to Dr. Stewart, the children are encouraged at a very early stage to regard their dream life as an important part of the natural world and to try to understand its import and to try to control their own role within their dreams. The result, according to Dr. Stewart, has been a society without crime or any other forms of severe social disruption. This is the case where the total community has taken on an inquiring style in a radical direction.

In the second part of this paper, the discussion has been held at a very general level in order to set the stage for more specific suggestions for educational research, which I'll describe within three styles of inquiry: the experimental, the systemic, and the philosophical.

The experimental style of inquiry, as I have said, emphasizes control and measurement. It attempts to be as precise and consistent as posisble and to control the variables in such ways that the inquirer feels that he is justified in making a substantially valid conclusion. It is doubtful whether it would be legitimate to call the experimental style "objective"; because, in its broadest sense, objectivity refers to the ability to grasp the essence of reality; whereas the experimental style in many cases does nothing of the kind. Indeed, the concept of objectivity in research that we have inherited from the Fifteenth and Sixteenth centuries probably needs a far broader meaning when we turn to problems of social change, for example, of the sort that would be entailed in the research on the maturation process of the inquiring mind.

Examine Reward System

The most obvious experimental study which might be made is to examine a revised reward system for education. In the model which claimed that the purpose of the college is to transfer knowledge, the reward system essentially becomes the grading system. It is taken for granted that the knowledge

inherent in a college, e.g., in the faculty's minds and the library, is adequate and does not need to be studied in depth, except at those infrequent times when the college itself is evaluated. It is, rather, the student's ability to receive knowledge that is being transmitted to him, which is taken to be the fundamental reward system. The grade that the student receives then represents a standard measure of accomplishment of students within the college system. The output can then be expressed as credit hours or scores on standard examinations, although it is questionable whether either of these is really a suitable output measure for the information-transmittal model, because within this model we are interested mainly in whether the student can use the transmitted information.

In the "inquiry" model which regards the college as essentially promoting the maturation of the inquiring mind, it is clear that since everyone is involved in the process, the process is to be evaluated primarily for the purpose of learning how the process proceeds, rather than trying to grade individuals in terms of their level of attainment. To be specific, suppose, for example, a college would entertain the prospect of an experiment in which there would be two student groups, both of them concerned with the ecological problems associated with air, water, and other types of pollution. The first group would be exposed to the usual courses in biology, engineering, etc., which are relevant to ecological problems. It would go through the normal process of consultation with faculty, the student's own individual course papers, and possibly a terminal "thesis." The student would receive grades in the usual manner.

In the second group, each student would work out his program in terms of his own inquiring style and interest. The faculty would not necessarily play a primary role in holding the group together, but would let the leadership characteristics develop within those individuals who have any interest in this aspect of inquiry. The group would decide on the type of personal contact each individual would find most useful. There would be no grades associated with the program. Naturally, formal courses may be held, because these may provide the optimal method of developing the students' style of learning; also, examinations may be held, because an examination provides a method of pulling together an assortment of things learned. Grades might still exist, with the idea that they provide a competitive environment so essential for many learners. But no one is required to take the course or the examination, or to compete for a grade. Thus the plan avoids the fallacy that because courses, grades, and examinations work well for a significant number of students, they should be required of all. Students would be expected, at the end, to try to evaluate their own learning process during the exposure and to point out its essential weaknesses.

Since this is an experimental program, according to its style it needs to come to some kind of a conclusion: "What is being tested in this program?" is the type of question the experimental mind naturally poses. It seems almost obvious in this case that what is being tested is the ability of the educational program both to transfer knowledge and to bring about a more mature inquiring mind. The evaluators therefore (in this case, the "experimenters") would be engaged in trying to determine the extent to which the first group, i.e., the group that is oriented toward the transfer of knowledge, has also brought about a "maturation of the inquiring style" in the individual. Consequently, the first group, in addition to the standard kinds of tests of its ability to acquire knowledge from various sources, would also be tested in terms of interest aroused by the group's program in further inquiry, i.e., the kinds of doubts and motivations for further learning that have been generated.

The second model of education that I discussed above obviously makes the interest in continued inquiry a fundamental measure of performance of the educational process. As a consequence, rather than just examining students in terms of what they have learned, the second model emphasizes an examination of students in terms of what they wish to learn or, if the study is a longitudinal one, the kinds of inquiry that they go into after a particular stage like the one being discussed. But the experimenter's aim would be to determine the extent to which the "transfer of knowledge" goal is met by the second group. In other words, we have two strategies of education, and two goals; does the experiment indicate that one strategy dominates the other with respect to both goals?

It is worth noting in this regard that the difficulties of defining a suitable output measure may be partially overcome if the planners have reduced the number of alternatives, e.g., in this case to two; and one alternative clearly dominates the other on all relevant criteria.

Systemics, a Broader Inquiry

Now, suppose we turn from the experimental approach to the other two, the systemic and philosophical. Systemic inquiry has to give up some of the control and precision of experimental inquiry because it reaches out into a broader do-

main. It may indeed have to give up consistency in its usual sense. If it is to be successful, systemic research definitely has to be imaginative and speculative. Some of the best literature on the future of society is systemic, in that the research obviously is not trying to establish once and for all what the future of society will be like; and in that the best researchers do use their own intuitions, imaginations, and speculative abilities to write their scenarios.

In the case of the suggestion that I am making in the second part of this paper, the need for systemic inquiry is clear enough. What the second model obviously suggests is an expansion of inquiry as a mode of human living so that literally every individual within the society has an intense interest in inquiry according to his own style. A very fundamental systemic question would be the societal implications of such an expansion of inquiry with respect to other social institutions. For example, it is perfectly clear that many, if not a majority of human beings, are intensely curious about the lives of other people. This curiosity is by no means restricted to the feminine side of the human race. It is very natural for us to be snoopers. (Indeed, snooping may be one of the main reasons why young men go into the social sciences.) An educational system that expands the natural inclinations to inquiry may, very well, also expand the natural inclination to snoop. What would such an expansion mean, say with respect to political institutions, to family structure, or to "law and order" institutions? As often happens, systemic inquiry takes us to the door of the house of morality, if not into the interior chambers. Will we have to add "consideration of others," or "fairness," as constraints on the natural inclination to inquiry?

Systemic inquiry is absolutely essential as a backup of input-output analysis; for what appears to be a reasonable output at one level of society may become a horror at another level, e.g., number of automobiles produced, or number of slum dwellings cleared. We have to determine where the output goes and what it does to other societal values when it gets there. By the same token, we need to know where the input comes from, and who sacrificed what to create it. In this regard, "actual dollars spent" may be quite a deceptive input, because the dollars spent may have deprived some very critical social programs from being adequately funded.

Finally, the systems analyst of recent years has tried to find some general "scoring system," like cost-benefit, to enable him to evaluate alternative plans. Naturally there has been considerable debate about the appropriateness of these scores; but in my opinion the systems analysis effort is worthwhile, especially since it tells us how little we really know about our marvelous suggestions for social change. Hence, I'd strongly support a systems study of any suggestion for radical change in education. Thus, if my "inquiry" model makes sense, we should examine the cost of the implied change of the educational process from an emphasis on the transmittal of knowledge to an emphasis on the maturation of the inquiring mind. Of course, this aspect of the inquiry will get into the details concerning the real difference between the two goals. Are we talking about a major change in educational institutions or merely a change in emphasis here and there? It is obviously premature to say whether the growing need for opening up inquiry really constitutes a major revolution in the institutional system. If it is a major revolution, naturally we would be led to assess the relevant cost of carrying out the changes. If it is realistically a minor change, then the cost considerations may not be all that relevant.

Recent events at Berkeley are good evidence of the uncertainty as to where we are in educational development; the campus is more or less split on the issue of whether we should "reconstitute" ourselves.

Philosophical Inquiry

These remarks take me to the last of the research efforts which I've called the philosophical. In this style of inquiry, one goes far beyond the precise, well-controlled, quantified considerations; and consistency is certainly not the highest value. In a philosophical mode of inquiry, the purpose is to reveal the underlying paradoxes of the intellectual process. The basic underlying paradox of all research on human societies can best be stated in the form of the following kind of question: How can we conduct systemic inquiry into the inquiring process? To say that it is possible to assess the costs and benefits associated with one type of educational program compared to another is to assume that we have the capability of educating ourselves in such an assessment. This assumption draws us into an immediate vicious circle. By what means can we educate ourselves about the best method of education without having presupposed the very answer to the question that we are asking?

The paradox has many different forms. One can raise the question, for example, of whether all educational planning does violence to the human individual, because it is essentially involved in trying to figure out ways in which we can change individuals' lives without knowing if we have the moral right to devote our time and energy to such efforts.

Here, again, is another warning for the input-output enthusiasts. I by no means imply that input-output analysis should be abandoned; such an implication would put me out of work. But the analytic enterprise will succeed far better if it examines its own foundations and, particularly, the morality of the enterprise.

Philosophical paradox is a difficult area of inquiry. For individuals whose inquiring style is experimental it turns out to be extremely frustrating; and their natural inclination of inquiry leads them to smudge the paradox, so to speak. Smudging paradoxes is not terribly difficult. The paradox itself is based on very broad considerations that are not well substantiated. Paradoxes, for example, can be smudged by making very, very careful distinctions concerning the meaning of terms. When one does make very careful distinctions, the paradox often disappears in the area in which the distinction is made. But the paradox by no means disappears in reality; because inevitably it will show up in some other domain even more critically. I make these remarks about smudging paradoxes in the hope of avoiding a fruitless discussion about the relevant importance of conducting philosophical research in the area of education. Such a discussion is apt to be fruitless, because it is based primarily on differences in individual inquiring styles. There's nothing that can be said definitively to the experimental inquirer which would lead him to believe that philosophical inquiry has much importance. By the same token, there's nothing very much one could say to the strongly philosophical or systemic inquirer that would lead him to believe that experimental inquiry is anything more than trivial. Perhaps if we can recognize that there are styles which, in large part, arise from our own intellectual backgrounds as well as our own personalities, the discussion could take on a more general and fruitful emphasis.

In summary, in this paper I have tried to go from a fairly specific question about educational policy and research to very general considerations. Within the more specific suggestions, I have tried to examine the ways in which research can be used to strengthen the teaching process, especially in the methodological disciplines. In the more general, I have tried to consider the very broad problems of educational policy and to contrast two different viewpoints: the viewpoint that the educational process at the college level is essentially a transmittal of knowledge versus the viewpoint that the educational process is essentially the development and maturation of the inquiring style of the individual. With regard to the second more general effort, I well recognize that may individuals, following their own inquiring style, will be inclined to say that educational process should do both, i.e., should both transmit knowledge and develop individual proclivities for inquiry. To keep the paper from falling apart, I suppose it would be essential to say that any such synthesis based on the concept of *"both"* certainly raises the whole question in its most serious form. How can we accomplish both goals?

Interest in Inquiry Killed

I should say that anyone who responds to the second part of the paper by "both" has not experienced the educational process in the way my own individual mode of inquiry has experienced it. For me, the contrast is a forceful one in the area where I do most of my work, i.e., graduate education. My own mode of inquiry has led me to conclude that most of our M.A. and Ph.D. programs are sadly lacking in their ability to create a keen interest in continuing inquiry. If it is true that most Ph.D.'s do not do research after receiving their degrees, then surely the output of Ph.D. programs is poor. I believe that most of our graduate programs, especially in the social science area, simply tend to produce people whose continued interest in inquiry has been killed off in the process of the program. So, although this has been in a sense a journey from the specific to the general, or from the practical to the sublime or ridiculous, nevertheless, I think the end of the journey has some extremely critical implications with respect to the practice of education at both undergraduate and graduate levels.

NOTE: As I remarked at the beginning, I well realize that many of the suggestions contained in this paper are being carried out, in one form or another, in various kinds of educational programs of research. I am familiar with some of them; many others I know nothing about. I've intentionally kept away from making references to the enormously growing literature in educational research, both at the experimental and the systemic and philosophical levels, some of which I have borrowed from shamelessly. I find in my own reading that such reference-making is disruptive of the thinking process of the author; because one is taken from the author's chain of reasoning into someone else's inquiring style, which never fits very well. Repeated citations of the form, "As X says," seem to be becoming an obnoxious method of defending one's ideas. It is clear that a paper of this kind is, after all, a very personal document based on one man's experience and his particular style of interpreting that experience. My debts are many and profound, but to include them in this paper would be a disservice to the reader and to other writers.

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"I would not waste much time trying to develop an index of total knowledge, discovered or transmitted, in the hope that I could then use it to evaluate alternative programs . . . Rather, I would begin by trying to understand very well where we are now, and on what basis allocation decisions are now being made, and what might be done to improve that basis."

"A cost analysis may identify some bad choices even without being able to indicate the right ones. This point is clearly related to another equally important one about program analysis; that is, analysis should be conceived as the servant of judgment, not a substitute for it."

"Universities need procedures for systematically re-allocating resources to reflect changing priorities caused by such factors as changing patterns of student demand. My impression is that most universities do not have such procedures."

"I would suggest . . . the greatly expanded use of external examinations rather than examinations set for each course by each professor."

Measures of the Outputs of Higher Education: Some Practical Suggestions for Their Development and Use

ALAIN C. ENTHOVEN

The purpose of this paper is to offer a few practical suggestions on the development and use of measures of the outputs of higher education. These suggestions are based mainly on my experience in the development and use of the Planning, Programming, and Budgeting System (PPBS) in the Department of Defense and on my experience as a member of the Board of Directors of Georgetown University. They also reflect a continuing interest in the economics of higher education and a modest amount of university teaching experience. They are preliminary and general thoughts, not definitive conclusions based on study in depth. Also, my experience in the Defense Department was in the use of data for analysis as a basis for program decisions; it was not in the technical details of management information systems. And my knowledge of the state of management of higher education is that of an interested outsider, not of a professional in the field.

Information Does Not Exist in Vacuum

Output and cost information does not exist in a vacuum. To be meaningful, each bit must be an answer to a precisely formulated question. In searching for output measures, it is important to keep the purpose of each measure clearly in mind. In the case of higher education programs, output measures may serve several different purposes:

1) *Aids in allocation decisions within the university* (In this case, output measures might help answer a question such as, "Which programs or departmental budgets shall we cut, and by how much, to make room for a growing Computer Science Department?")
2) *Aids in broader allocation decisions between higher education and other public programs* (For example, "What benefit will result for our state from the expenditure of an additional $10 million on higher education?")
3) *Aids in evaluating the effectiveness of different teachers, teaching methods, or curricula* (For example, "Is computer-aided instruction better than the traditional method of teaching elementary Russian to undergraduates?")

Measures for different purposes are answers to different questions. They do not have to be the same. In fact, they probably will not be the same. Moreover, we may have no explicit way of relating one to another.

Let me illustrate this with an example from program analysis work in the Defense Department. The Department has studied various programs for the purpose of limiting the numbers of Americans who would be killed in the event of a nuclear war. The list includes:

1) Air (anti-bomber) defense forces, including interceptor aircraft, surface-to-air missiles, radars, and communication and control systems
2) Anti-ballistic missile (ABM) systems
3) Fallout shelters

For purpose of allocation decisions among different continental air defense systems, the number of enemy bombers shot down before they reach their targets is a good criterion. It is also a good criterion for evaluating the performance of the air defense system in exercises. But an analysis intended to aid such broader decisions as the allocation among air defense, anti-ballistic missile defense, and fallout shelters, or a decision on the allocation between these programs, taken together, and other programs must be based on a broader criterion, such as the number of lives saved in various circumstances.

In this particular case — continental air and missile defense forces and other so-called "damage limiting programs" — we were able to develop a unified theory by which the specific performance indicators of individual weapon systems could be related explicitly to the broad overall objective of saving American lives. Thus, output measures useful for judging the balance between these and other programs were either the same as or could be explicitly related to output measures useful for judging the balance among these programs and for evaluating performance. But this was an exception, not the rule. Only in a few cases was this possible. Generally it wasn't. For example, we have no criteria or calculations that relate the speed or payload of our fighter-bombers to our ability to defend Europe. And even in the case of the "damage-limiting" programs, the question of criterion

was not simple. The comparative effectiveness of different program mixes changed with different assumptions about the circumstances surrounding the outbreak and conduct of the war. Thus, value judgments had to be made about how much we wanted to protect in which circumstances.

In this paper I propose to discuss mainly the first of these purposes of output measures, that is, aids to allocation decisions within the university. And I propose to limit that to undergraduate and postgraduate instruction.

Developing Criteria

In developing criteria for program decisions, it is important to set one's sights on realistic objectives. It is difficult to go far beyond crude, simple criteria; but such criteria can prove to be surprisingly useful.

Development of output measures for public programs is an inductive process, not a deductive one. It is a matter of cut and try, of successive approximations. One should not expect to be able to deduce a hierarchy of criteria that will logically order the university program. I doubt very much that it will ever be possible to do a satisfactory job of relating alternative instructional programs to such broad measures of social welfare as increases in state or national wealth, increases in knowledge, good citizenship, or personal happiness. Rather, one should start with simple, crude criteria, and then attempt to refine them.

I learned this lesson the hard way in the Defense Department. In the early 1960s, I began working on the question of tactical air force requirements. I started by thinking that it would be possible to develop a unified analysis for land forces and tactical air forces. We reasoned that the effectiveness of the classical tactical air missions in a conventional war — air superiority, close air support, and interdiction — could be measured by their impact on the land force ratio between opposing forces at the front, and thus that the land-air "tradeoff" would be a decisive factor in determining the size of U. S. tactical air forces. Approaching the problem in the manner of an economist or operations analyst, my colleagues in the Systems Analysis Office and I tried to develop tradeoff curves for land and air forces yielding the same effectiveness.

Unfortunately, we were quite unsuccessful. We simply could not find the relevant data with which to calculate how much better the land force ratio would be if we had another wing of tactical air forces in a particular theatre. Nor could we get a reasoned judgment from the military experts, based on the available data.

After blunting our lance for several years on the land-air tradeoff problem, we realized that the actual decision-making was being based on much simpler criteria, such as a comparative count of enemy aircraft versus ours. And we realized that some military recommendations to the Secretary of Defense were based on counts that were badly wrong. They were wrong for several reasons. First, the definitions used had the effect of comparing a number close to the total inventory of our potential enemies with a much smaller fraction of our inventory. Second, they ignored important qualitative differences between our and enemy aircraft. For example, a typical NATO fighter-bomber aircraft can deliver about two and one-half times the payload of a typical Warsaw Pact plane over a representative combat sortie.

So, in 1964, we switched our effort from trying to develop a sophisticated solution to the total tactical air requirements problem to just getting the numerical counts straight, and to developing effectiveness indicators that would take account of the expensive qualitative advantages being built into U. S. aircraft. In retrospect, we should have made this switch sooner.

One of our early efforts was a simple index of the total payload that our forces and enemy forces could carry on representative sorties. This index showed that the total payload of U. S. forces, which was about equal to the total of all Communist forces in 1961, had more than doubled by 1967, while the Communist total grew by only 23 per cent.

The Secretary of Defense used this index very effectively to refute charges that enemy forces were more powerful than our own. The use of the payload index was immediately met by the Joint Chiefs of Staff with the argument that "payload is not the same as force effectiveness." But the Secretary of Defense was able to respond along the following lines: "I agree. It's a very crude index. But it is a lot better than just numbers of aircraft, and it gives a much more accurate picture of the growth in our total capability. So I am going to go on using it until a better measure is available." And he did.

Simple, Crude Indices Helpful

This experience taught me that one should not expect to find an all-embracing criterion of value added or effectiveness, and such criteria really aren't necessary for improved allocation decisions.

Simple, crude indices can be very useful. This and similar experiences inspired the motto, "It is better to be roughly right than exactly wrong."

Applying this lesson to the university scene, I would not waste much time trying to develop an index of total knowledge, discovered or transmitted, in the hope that I could then use it to evaluate alternative programs. That is a conceptual box that is very likely always to remain empty. Rather, I would begin by trying to understand very well where we are now, and on what basis allocation decisions are now being made, and what might be done to improve that basis.

A related point is that analysis can illuminate program choices among quite dissimilar programs even in the absence of a criterion that measures them both. For example, implicitly, the Secretary of Defense had to allocate the defense budget between continental air defense forces and airlift/sealift forces for the rapid deployment of our forces overseas. We had no unifying criterion spanning the output of these activities. But we could calculate, for example, how many extra lives would be saved by an extra billion dollars spent on continental air defense. And we could calculate how much faster a billion dollars would permit us to deploy reinforcements to key overseas areas. This information could and did illuminate such choices for the Secretary by making clearer for him the judgments he had to make. I am sure the same point applies in the analysis of alternative university programs. It isn't necessary to be able to measure the ultimate social value of alternative programs in order to improve the basis on which such choices are made.

Universities are thought to serve many purposes. Mark Blaug mentions a few: " To select the most able for leadership in industry and government, to cultivate talent for the sake of self-enrichment, to promote scholarship and scientific research, to preserve and disseminate cultural values . . . ."[1] John Keller mentions several views: (1) the university's objectives are the preservation, transmission, and application of knowledge, and the augmentation of the stock of knowledge; (2) the university is a service industry responsive to consumer demand; (3) the university is a producer of human capital for the economic development of society; (4) the university is a source of instructional, research, and public services.[2] The list could go on and on. It is clear to me that there never will be agreement on one or even a few of these purposes as preeminent or as the basis for allocation decisions. But such agreement is not necessary to the development of an analytical basis for substantially improved allocation decisions.

Because there is no agreement on purposes or on relatives values, there is no "optimum" program for the university. There are only better and worse programs. Avoiding bad programs is a sufficiently ambitious goal to keep us all occupied for many years.

This is a very important point about policy analysis. Much of the literature on analytical method is based on the notion of finding an "optimum" solution, given some unique criterion and a set of alternatives. But as a practical matter, there are many relevant criteria involved in every decision. However, finding a solution better by most or all of the relevant criteria than the one currently in operation, is often possible. So is the identification of programs that are quite clearly poor choices. Let me give a couple of examples.

In the early 1960s the Secretary of Defense had to decide how many Minuteman ICBMs to include in the defense program. The Chief of Staff of the Air Force recommended some 2,400. To help the Secretary reach an informed judgment on the matter, we made a graph showing the number of targets destroyed as a function of the number of missiles for each of various assumptions. As one might expect, with increasing numbers of missiles, the curve became very flat, reflecting the fact that, after a point, missiles were being used to reattack for the second or third time targets that had already been attacked once. In fact, the curves became pretty flat around 1,000 ICBMs. But there was no simple "point of diminishing returns" or "optimum point." The curve didn't tell the Secretary what the right number of missiles was. But it did enable him to identify a lot of bad answers — that is, numbers of missiles substantially in excess of 1,000 — and that was a very useful result.

Similarities Seen

A great deal of the useful Systems Analysis work in the Defense Department was the identification of such "flat of the curve" situations. I am sure that such situations can be found in most university programs. Two examples that come to mind (I believe but can't prove) are the fifth and subsequent years in Ph.D. programs and certain reductions in class size such as, for example, from 100 to 80. When I have raised these issues on campuses, the replies have always been couched in terms of the absolute benefits of longer study and smaller classes. But that is the wrong way to look at the question. The real issue concerns the marginal benefits — the extra knowledge associated with five years compared to four, or classes of 80 compared to 100 — compared to the alternative uses

of the same resources. I don't doubt that a man who spends five years on his Ph.D. is likely to know more about his subject than he would if he had spent four, although whether he will know more at the end of the fifth year than he would if he had spent the year some other way depends in part on how he would otherwise have spent the fifth year. But suppose the department in question has room for 100 Ph.D. candidates. If it takes five years for each candidate to get his degree, the department will produce 20 Ph.D.'s per year. If the course can be reduced to four years, the output can be increased to 25 Ph.D.'s per year at the same cost to the university. The latter might be a much better use of university resources.

At Georgetown, Professor Bruce Davie of the Economics department did an analysis of cost per student credit hour taught in the various departments and costs per credit hour enrolled in each of the various academic programs. The analysis showed that the cost per underdgraduate student credit hour in one of the sciences was more than twice the cost in another. John Keller reported that a cost analysis of the Berkeley campus showed a six to one differential between the disciplines with the highest and lowest costs per student year at a given level.[3] There is no way to prove that approximate equality of costs among disciplines is right. But it isn't necessary to obtain such a proof to get agreement that cost differentials beyond certain limits are not acceptable unless explained by special circumstances. Thus, a cost analysis may identify some bad choices even without being able to indicate the right ones.

This point is closely related to another equally important one about program analysis; that is, analysis should be conceived of as the servant of judgment, not a substitute for it. Thus, work on output measures should not be directed to an attempt to find criteria that will form a wholly rational basis for decision-making, that will free the responsible officials from the burden of making judgments and hard choices. Such an attempt would be bound to fail. Rather, efforts on development of output measures should be made in recognition from the outset that decision-makers are going to have to make judgments. Thus, such efforts should start where the decision-makers are now, and attempt to increase the amount of useful information available to them.

Another lesson we learned from building the Planning-Programming-Budgeting System in the Pentagon is that there is no single "best" way to slice the program data. Up to 1960 the only way the Defense budget was subdivided was by Military Department (Army, Navy, Air Force) and by object class of expenditure (procurement, operations and maintenance, construction, research and development, and military personnel). This breakdown didn't help to answer many fundamental questions about the shape of the Defense program. In the early 1960s, under the leadership of Charles Hitch, then Comptroller of the Defense Department, we developed a mission or output oriented breakdown of the budget as the main frame of reference for program decision-making; that is, Strategic Retaliatory Forces, Continental Air and Missile Defense Forces, etc.

But we soon found that the budget data had to be sliced up in other ways also. For example, for studies of our posture in and for NATO, we had to develop a breakdown by theatre. For analysis of training, housing, medical support, etc., we had to look at manpower regardless of mission, etc.

Similarly, I am sure that analysts of university programs will need to continue to break down the budgets by department, school, degree program, level (lower division, upper division, etc.), object of expenditure, and other ways. Generally speaking, this means beginning with the budgets of organizations that are cost centers, developing cost models that will permit estimation of other cost breakdowns, and it means building more flexibility into the management information system so that adaptation can be made to changing needs.

Good Analysis Provides Ground Rules

I remarked earlier that analysis is not a substitute for judgment. It is not a substitute for debate either. Rather, a good analysis can provide the ground rules for a constructive convergent debate that narrows differences and clarifies issues and points of disagreement. In fact, debate is usually a necessary stimulant to analytical progress. It certainly was the case during my years in the Pentagon that many of the most significant analytical advances were developed in the midst of intense debate. And I am sure that a good source of output measures for academic programs would be academic departments that have been requested to justify their budget requests in such terms. Defense departments, universities, and other institutions do not discover their goals by speculating on them in abstract; they discover them by making hard choices from among the real alternatives they face.

We had the beginnings of some useful debate last year at Georgetown University. As I mentioned earlier, Professor Bruce Davie of the Eco-

nomics department did an analysis of cost per student credit hour. This exercise put the spotlight on some of the high-cost departments. Some of the high costs, of course, were justified. For example, it turned out that the Classics department was among the most expensive by this criterion. But the reason for this was that, although the department was small, the enrollment was proportionately smaller. To reduce the cost per student credit hour would have required reducing the size of the faculty. But agreement was easily obtained that the Classics department was already at a minimum critical size, so that proposals to reduce it would raise the question of its continued existence. But it was also agreed that it was an important part of our values at Georgetown to have a strong Classics department. Moreover, although the cost per student credit hour was high, the total cost of the department was small. So no issue developed concerning this department.

However, the story was different with other departments. The Mathematics department, as I recall, argued that a three-credit course in math was equivalent to five-credit courses in other departments. That opened up such interesting questions as the meaning of a credit hour — which forces one back to the question of output.

As I mentioned earlier, Professor Davie found that one of the Science departments cost twice what another did to produce a student credit hour. Such differences can be analyzed and the reasons evaluated. Are faculty salaries higher in one department than another? If so, is it because salaries in general in one field are higher than the other? Or is it because one department head is a stronger bargainer than another? Or is there objective evidence that one department attracts a higher caliber of professor than the other? Or is it that one department contains more senior people than the other? How much of the cost difference is explained by differences in class size and teaching loads? etc. Of course, it can be dangerous to look at the cost side alone. A department could produce student credit hours very cheaply by resorting to very large classes and very low-paid personnel and by doing a poor job of teaching. It is also important to look at the quality of the product, some indication of which can be obtained through such means as graduate record exams.

A process of analysis and debate in which high-cost departments are challenged to defend their position, if properly managed, can yield many useful insights. On the other hand, an analytical effort is unlikely to bear much fruit if it is approached as a purely intellectual exercise of only academic interest. There are too many "unanswerable questions" that won't be attacked unless they have to be. My experience has been that, as a practical matter, a necessary condition for good program analysis is that it is really tied in to the decision process.

The fact that a cost-benefit analysis cannot prove the existence of a best answer should not be discouraging to the program analyst who starts with the right perspective. Choices have to be made, whether implicitly or explicitly. Rather than judging his achievement against the model of the theoretical literature in which the alternatives are defined and the criterion is unique, he should judge it against the actual situation in which decisions are being made with imperfect information and a multiplicity of criteria. He should try to design or stimulate others to design new solutions that may be both more effective and cheaper. And short of that, he can identify programs whose costs are so out of proportion to their benefits that most disinterested participants in the decision process will agree that action should be taken to change them.

Incentives Needed To Produce Change

Now let us return to the purpose of output measurement. Suppose that we are successful in developing a set of meaningful and convincing output measures. Will this result in better program decisions? Not necessarily. One must look at institutional decision processes and at the incentives that actually influence decision-makers. Even with good information and good decision-makers, good decisions from an overall university or public point of view will not result automatically.

Universities need procedures for systematically re-allocating resources to reflect changing priorities caused by such factors as changing patterns of student demand. My impression is that most universities do not have such procedures. Of course, the process should be reasonably damped so that it will not over-react to temporary changes. And the process should allow for the application of value judgments. I would not want to see the rigid application of a rule on cost per course wipe out the Classics department. But if student demand is growing in one area, and declining in another, subject to these factors, re-allocation ought to occur.

We need to encourage experiments with different class sizes. I personally believe that once a class exceeds 20 or 30 students, the teacher is, for all practical purposes, lecturing (and he might as well be lecturing to 1,000). Classes ought to be

either very small, to permit the stimulation of dialogue, or very large, to take advantage of economies of scale. Classes between, say, 30 and 300 are wasteful. Yet most university classes fall within that range. Many people do not agree with this view. And I have no evidence on the output side to support it. But evidence can and should be developed to test such hypotheses. If one is willing to accept the results of "before and after" examinations as measures of value added — and I would be — then it should not be difficult to organize experiments that would provide answers.

Experimentation with the use of technology, such as closed circuit TV and computers, ought to be expanded greatly. The lecture system in American universities has long seemed to me to be a poor use of resources. But if we must have it, why not do it with taped lectures on closed circuit TV? This could solve the problem that many of our classrooms are not big enough for large lectures. The same lecture could be shown in several classrooms. Also, by showing the lectures at different times, one could ease the difficult scheduling problems universities face. Better still, students in western universities could get their lectures on American Intellectual History from Arthur Schlesinger, Jr., and their lectures in Principles of Economics from Paul Samuelson, while their local professors would be freed to meet with them in small groups. I think this last point would be the greatest advantage.

At Stanford, Professor Patrick Suppes and his associates have developed programs for computer-aided instruction. A program is now in use for teaching elementary Russian to Stanford undergraduates. Some students are taught in the traditional manner, others with the computer program. Last year it was reported that the percentage of students successfully completing the first year course was substantially higher for the computer-aided group than for the group following the traditional method. The main reason for this is that the student using the computer system can work at his own pace.

It should not be difficult to combine such an experiment with a cost analysis to produce estimates, for example, of the cost to the university of producing a successful student under each method.

No "Best" Solution

This example can be used to illustrate a point that I made earlier to the effect that there is no "best" solution. One might think that cost to the university per successful student is a good criterion for choice between the two teaching methods. But it may not be an adequate criterion. Suppose, for example, that 60 per cent of the students complete the course under the traditional method while 80 per cent do under the computer-aided method? Suppose, nevertheless, that the computer-aided method costs so much more that even the cost per successful student is 20 per cent higher using it? It is certainly not obvious that one should therefore reject the computer-aided method. One must consider the value of the students' time. Presumably, those 20 per cent of the students who dropped out or failed under the traditional method, but who would have succeeded under the computer-aided method have pretty much wasted their time. And one must consider the value to those students of successfully completing the course. Value judgments on these matters are inescapable. And the values that are involved are of interest to the students, the university, the public (which supports the university), as well as the department presumably making the decision. This makes the question of the incentives influencing the decision-makers all the more important.

But many experiments and innovations that would improve effectiveness and efficiency are not going to be made as long as academic departmental incentives are the way they are. Academic departments are not seeking to maximize output, given a certain budget, or to minimize the cost of doing their job. Rather, they are trying to maximize indicators of their prestige, such as numbers of members and of publications, and the freedom to pursue independent scholarly interests. My point is not that this is wrong, or that professors and their department heads are not good and public-spirited people. The point I want to make is simply that this is the way departments behave in fact. This is not a phenomenon that is unique to the academic profession. It has its counterparts in all walks of life. But it is a fact that we would do well to recognize explicitly if we want our efforts to improve university resource allocation to be fruitful.

Let me give some examples. A number of years ago, at the end of a visit to a university economics department, I made a number of suggestions for the realignment of their teaching program. They were using the introductory courses as "fillers" in the schedules of all their teachers, with the result that nobody had full-time responsibility for the introductory courses, the courses were not being taught well, and they were being taught very uneconomically, with lectures being given to classes varying in size from 30 students to 300. I suggested to the department that it should select its most

effective and attractive lecturer, relieve him of all other duties, assign him the job of giving the introductory lectures to very large audiences, perhaps at two different hours to facilitate scheduling. This would assure that the lectures would be done well, and it would save a lot of money because the uneconomical lectures would be replaced by one or two very economical ones. Part of the savings could be used to pay for more small seminars and/or lighter teaching loads. Thus, it would be a very good thing from the university's point of view. Also, it would be good from the point of view of the department's own narrow interest. Exposing all the undergraduates to the department's most attractive lecturer would help to increase the number of undergraduates majoring in Economics.

My hosts agreed with the merits of the proposal, but said that they had no incentive to do it because the university would not let the department keep the savings. Rather, the effect would be a reduced departmental budget. And so my proposal was not acted upon.

Check the Catalogues

You can find evidence of this problem by looking at the catalogue of course offerings of many departments in many universities. What you will often find is a crazy-quilt of specialized offerings reflecting the special interests of the professors, rather than a balanced, broad, and economical curriculum plan designed to take the student in an orderly way through the fundamentals of his chosen field.

"Why are you offering a course in the development of Adam Smith's thought from 1774 to 1776?"

"Oh, that's how we attracted Professor X away from Berkeley."

It is fine for the department's prestige standing, but poor for the economics of the instructional program.

The same incentives operate on departmental attitudes toward increased class sizes. Departments will resist increasing average class size from 100 to, say, 120 (an increase that I believe must be "on the flat of the curve" from the point of view of teaching effectiveness) because that will weaken their cases for hiring more faculty. And I believe that even if computer-aided instruction can be shown to be both better and cheaper, it won't be adopted by departments which see expenditure on computer time as an alternative to expenditure on staff. Given the choice between a red-blooded, paper-publishing, committee-attending, prestige-building colleague and a computer, what department head is going to pick the computer? Or use closed-circuit TV? Or redesign his curriculum?

What can be done about the problem of departmental incentives? Recognizing its existence is a useful step, but there is no simple answer. Among other things, what any single university can accomplish is limited by the fact that the national profession in each discipline is an important factor governing curriculum and teaching method. And the incentives of the profession (e.g., "raise quality") may be different from and even opposed to the interests of the university and the public.

Without pretending that I have a solution to the problem, I would like to suggest three lines of attack on it.

Three Lines of Attack

The first is appropriate financial incentives. When a department proposes a cost-reducing innovation, it should be allowed to keep the savings, at least within limits and for a time. It is especially important that the budgetary process not reward the most inefficient with larger budgets. So often departments in any bureaucracy can successfully strengthen their case for bigger budgets by doing their job less efficiently. Changes in budgets should be positively related by general rules to changes in numbers of students taught, or better measures of output if they are available. Changes should not be based on such things as complaints that a particular faculty is overworked. After all, a department can always adjust the faculty workloads by various means, including design of course offerings.

The second line of attack I would suggest is the greatly expanded use of external examinations rather than examinations set for each course by each professor. I think external examinations offer many advantages. First, they can set broad standards of achievement, independent of the personal preferences of any particular teacher, and thus they can serve (with proper correction for the knowledge and ability of the student input) as measures of the teacher's and department's teaching performance. I should think it would be very helpful to a university administration to know how each of its departments is doing in preparing its students, compared to a large sample of universities. Second, they can change the whole relationship between student and teacher. If the examiners are external, the teacher can become the student's collaborator in the effort to achieve a common objective, rather than being the student's judge.

Third, external examinations designed to reflect a consensus of the profession as to what a student should know would give the teacher a strong incentive to cover the broad fundamentals in his field, rather than spending all of the student's time exploring specialized byways. I think that WICHE could make a very useful contribution to its members by taking the lead in organizing the development and use of such examinations.

My third suggestion for attacking institutional incentives for inefficiency parallels one of the main McNamara reforms in the Pentagon, that is, the establishment of a strong office of program analysis and review — we called it the Systems Analysis Office — as an active participant in the decision process. Some universities already have established such offices with the title, Office of Institutional Research. But as I hope I have made clear in this paper, such an office should play a much more active role than that suggested by the title, "Institutional Research." The office should do analyses and stimulate others to do counter-analyses. It should develop criteria for evaluating programs. It should seek out and evaluate new ideas, and try to put the good ones into application. For example, if an analysis shows that computer-aided instruction is definitely better and cheaper for introductory courses in modern languages, it should confront the Modern Languages department with the analysis. If the department cannot disprove the analysis, the office should bring pressure to bear through the budget to get the department to take appropriate action. The office should challenge questionable programs in the budget review. It might begin by developing a model of the university's costs that would permit estimates of cost per student credit hour and then cost per degree program. The latter could be used, for example, in analyses of the costs associated with long Ph.D. programs. From there the office might go on to an examination of the incentives the departments have to be efficient, and to develop ways of better aligning the individual departmental interest with the overall university interest. And, in collaboration with the academic departments, the office might plan and manage a program of experimentation with different teaching methods.

Good output measures are not likely to come from disinterested speculation; they are much more likely to emerge from the cut and thrust of debate over real program issues, provided that the decision process favors the side with the better analysis and criteria.

NOTES

1. "The Productivity of Universities," *Minerva* 6, Spring 1968.

2. "Higher Education Objectives: Measures of Performance and Effectiveness," *Management Information Systems: Their Development and Use in the Administration of Higher Education*, Boulder, Colorado: WICHE, October 1969.

3. *Ibid.*, p. 83.

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In August 1968, he received the National Bar Association's highest award for "...leadership, integrity, legal skill, and devotion to duty." He is the youngest man ever to receive the award.

Active in civic and state affairs, Dean Tollett has made significant contributions to understanding and respect for all men among men.

He and his wife have two teenaged daughters.

"One of the great challenges to higher education today is to continue to go about its frequently disturbing mission without unduly disenchanting, antagonizing, and disrupting the public sector."

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"Students . . . seeking relevancy between knowledge and action, learning and life, instead find . . . research grantsmanship and academic arrogance. Faculty members make more and teach less; work shorter hours and take longer leaves; obtain rank from universities and pull rank on students; and last but not least, they seek tenure and avoid students."

"No society can exist without a measure of order. Here you see . . . my own special concern for law and order."

Higher Education and the Public Sector

KENNETH S. TOLLETT

Introduction: Disenchantment with Higher Education

I recently spoke to a group of high school seniors on the role of law in international relations and said in the course of my speech that I was preoccupied with determining the requirements for a universal community of concord and peace. A young student quickly commented that that was easy: All that was necessary was the spread of the Christian religion. I replied that I was not sanguine about his answer in any respect because my study of the history of religions, including Christianity, gave me little reason for believing that religion was a source of the salvation of man on earth. He bitterly retorted that I was an example of what was wrong with higher education. As soon as you read a few books and learn a little something, you lose faith in the power and force for good of religion.

This smart young student's perception of the impact of higher education upon me and others expresses in simple form the anxious view the public sector has of the outputs of higher education. I use this example of the youthful suspicion that higher education seemingly desanctifies and confuses life not in order to suggest that educators should look upon the public sector as adolescent, but in order to clearly indicate the educator's almost absolute responsibility to take seriously the suspicions and queries of the public sector. There was a profound insight in the young student's observation which cannot be gainsaid. Education frequently does unsettle conventional faith and accepted wisdom in such a way that society, naturally — just as the young student — becomes anxious about its consequences. Of course, this natural uneasiness about higher education has been exacerbated by recent student unrest, protest, and disruptions. One of the great challenges to higher education today is to continue to go about its frequently disturbing mission without unduly disenchanting, antagonizing, and disrupting the public sector.

However, this is just one aspect of the higher education impact or output problem. It concerns higher education's effect upon student belief and, thus, behavior. Yet, there are other impacts which compound the problem of public disenchantment. Higher educational institutions not only discover and transmit knowledge which undermines sacred beliefs, but, also, especially according to post-modern youth and radical academic critics, create and disseminate science and technology which are progressively and pervasively destroying the environment and vitiating "the quality of life" — whatever that means. As if the undermining of beliefs, corruption of behavior, and destruction of environment were not enough, the public cost of and expenditures for higher education have risen at a staggering rate, particularly the federal outlay.[1] This all adds up to what David Riesman calls " . . . the collision course of higher education." What is taking place is that,

> . . . tremendous pressures now on higher education to increase what it provides to diverse constituencies at the same time that the taxpaying public, as represented in legislatures, grows somewhat disenchanted.[2]

State and local government outlays for higher education have increased substantially, also, so that the combined outlays of national, state, and local governments amount to about fifty per cent of the expenditures on higher education.

Nothing talks like money and we never get tired of listening to it. The public sector's expanded support of higher education, which began with the federal Morrill Act of 1862 (the first College Land Grant Act), continued apace with state and local government involvement and interest in public education generally after the Civil War. One of the great contributions to United States development came from Reconstruction legislatures in the South which gave free public education its first real boost in the South. Although this financial support aspect of higher education, together with the emergent predominant role in terms of number of students enrolled of public higher educational institutions, more than legitimizes a serious attempt to view higher educational impact and outputs from the public viewpoint, one should be warned against overrating this legitimacy in principle. After all, about fifty per cent of the *cash outlays* needed for college attendance comes from students, their parents, private gifts, and other non-public or non-governmental sources. However, if one thinks in terms of *economic cost,* particularly " . . . the loss of earnings to the student because he has chosen not to be in the labor force,"[3] then it is realized that the public is not paying the piper as much as it thinks or it appears. In fact, Dr. Bowen contends, "The student's share at present is of the

order of three-fourths to seven-eighths of the total cost of education, including the educational expense of institutions."[4] This fact should chasten the overreacting interventionism of the public sector into higher education and enhance the beseeching participation in the governance of higher education by students. Yet if higher education has great impact upon society in any way, then society, the public sector, should want to know what that impact is and evaluate, modify, or reinforce, as the situation may require, that impact.

Impact of Higher Education Upon Society

That higher education has great impact, one way or another upon society, few would deny. Just what that impact is, many would disagree. This state of consensus, disagreement, and confusion about higher education more than justifies this seminar on "The Outputs of Higher Education."

Before exploring the impact of higher education upon society, one other recent reaction to higher education must be dealt with briefly. I speak here of the re-emerging complaint that too many people want to pursue some kind of post-high school formal education. Although it might be preferable to defer comment upon this elitist phenomenon until after I have explored higher education's impact upon society, I think that I should do it now, so that I can early reveal my strong personal bias that the expansion and fulfillment of universal higher educational opportunity should be accelerated. I believe intellectual integrity requires the disclosure of biases or prejudices early in any discourse.

A recent comment in *Change*[5] entitled, "The Involuntary Campus," writes of too much emphasis on going to college and getting more and more advanced degrees. After noting that minority groups see the degree as a way of making it and employers demanding it, the article observes, "It all adds up to academic inflation." It then attacks credentialism and concludes, "If we don't watch out, the degree may go the way of Confederate money." This is easy enough to write for someone who has already made it or is making it, but what about underprivileged blacks and other unskilled and semi-skilled underclasses? The degree fetish and other forms of credentialism are troublesome, but is it possible to de-emphasize credentials without de-emphasizing what the credentials or degrees are supposed to stand for? The Ph.D. and other degrees and certificates could stand a good overhaul, but I hope the baby is not thrown out with the stale bath water.

A similar, but more learned, criticism or complaint is made by Dr. Martin Trow in a recent *Daedalus* article entitled, "Reflections on the Transition from Mass to Universal Higher Education."[6] Under subheading, " 'Compulsory' Higher Education," he observes,

> . . . the expansion of American higher education, in numbers and functions, is transforming it from a system of mass higher education into one that will bear responsibility for nearly all of the college-age population — that is, into a system of universal education.[7]

Although the trend toward a system of universal higher education is obscured by the fact that upper-middle class high school graduates attend some form of post-secondary education at a rate of over 80 per cent and the lower classes at about 50 per cent, more significantly the lower classes and generally upward-mobile students perceive the high rate of middle class attendance as correlated to the middle class' apparent well-being and status. Upper-middle class peer-group pressure may compel college attendance by many upper-middle class students, who are not motivated but bored, and thus may be disruptive and unappreciative of the opportunities higher education affords them. Nevertheless, blacks and large numbers of other underclasses correctly, I believe, see post-high school education as a way to make it in a still very success- and middle class-oriented society. The amenities and perquisites of upper-middle class affluence may not be as satisfying as they appear *from below*, but those below would like to *rise above* to decide for themselves whether affluence and high places are shallow, empty, or meaningless.

The Carnegie Commission[8] has taken a very progressive, but responsible, position on access to higher education. The Commission said:

> We do not believe that each young person should of necessity attend college. Quite the contrary. Many do not want and will not wish to attend, and it cannot be shown that all young persons will benefit sufficiently from attendance to justify their time and the expense involved. We should resist efforts to create a "captive" audience in our colleges . . . We therefore oppose universal *attendance* as a goal of American higher education and believe that noncollege alternatives should be made more available and more attractive to young people.
>
> We favor, on the other hand, universal access for those who want to enter institutions of higher education, are able to make reasonable progress after enrollment, and can benefit from attendance.[9]

This position is sufficiently progressive to inspire widespread support, but it is not necessarily as progressive as it could be. There is much justification in the *Washington Post*, March 6. 1970 editorial comment upon the Commission's distinction between universal *access* and universal *attendance*. The *Post* said:

> There is implicit in this distinction, we fear, an acceptance of the idea that there are some who were born to be hewers of wood and drawers of water . . . But perhaps the ultimate goal should be to make everyone to want this (higher education) to inculcate in the country's youth, through its system of elementary and secondary education, a love of learning and a capacity to pursue it.

Although the *Post* may be implicitly demeaning the hewing of wood and the drawing of water, I believe it has set forth the necessary ideal. In the discussion to follow, I hope to set forth some factual and further rational basis for my bias.

With these preliminary and general comments out of the way, I can now turn to a more detailed discussion of higher education's impact upon society from the viewpoint of the public sector. Various aspects, processes, and products or outputs of education will be commented upon. They all intermesh in a complex kaleidoscope. I will look at the undergraduate, graduate, research, and social involvement or extension aspects of higher education. These aspects involve the teaching, research, and community-service processes of higher education. These all converge and have impact upon students, economy, politics, and culture. In order to give some coherence and organization to the discussion I will approach these aspects, processes, and products or outputs in terms of society's economy, politics, and culture.

Economic Impact

Symptomatic of the underdeveloped stage of social science is the quick resort to economic concepts in order to explicate and rationalize social phenomena and institutions. This has taken place in higher education in part because of the self-consciousness of educators and the public about the extent to which the public sector is subsidizing or financing higher education. It is also a compliment to economics in that it seems to have advanced farther than most social sciences in developing concepts for rigorous analysis of social processes. The very title of this seminar expresses the recognition that if one wants to measure what higher education is up to, it is useful to talk in terms of the outputs of higher education — outputs being, uniquely, an economic concept.

Production Function

Output is a concept in economics used to analyze the production process. Labor, land, and material are inputs in the production process and cars, airplanes, food, services, and housing accommodations are outputs of the production process. Thus, one can speak of higher education, as Dr. Clark Kerr and Dr. Theodore W. Schultz[10] have spoken of it, in terms of providing or performing a series of services related to production. This production function of higher education involves activities which add to the output of goods and services in society. In other words, "Higher education is engaged in three major types of production activities which entail *discovering talent, instruction,* and *research.*"[11] To put this another way, higher educational institutions train people vocationally, they seek people with talent so that they can be educated and perform production functions for society, and they engage in research for the purpose of developing a technology and an economy which are continuously expanding. And, of course, the university through formal and informal consultations can render aid to the government and to industry. We know that there is an especially great concern about universities performing this production function in a particular sphere and form — namely, giving advice, counsel, and research aid to the military-industrial complex.

There is an inevitable ambiguity in speaking of the production function of higher education. Higher education as a production process or activity naturally implies it is subject to traditional and modern economical analysis. Since other institutions engage in the same activities as higher education, immediately the question may arise how efficiently and effectively does it discover talent, instruct future workers, and do research compared to other institutions or to alternative ways of carrying out these activities?

Furthermore, these activities result in two principal products or outputs: (1) Student-graduate, discovered and trained, and (2) knowledge. Another question may then arise. What is the market for variously trained undergraduate, graduate, and professional students and for knowledge of various subject matters? In other words, higher education as a production activity must also be concerned about the problem of product mix and market. An obvious measure here is the demand for and success of various former students and graduates of higher education in obtaining remunerative employment and satisfying careers.

Yet the production function of higher education was operationally defined as performing a series of *services related to production.* Although services may be regarded as and subjected to economic analysis just as well as goods, many services are not subjected to traditional or even new economic analysis. How do you really evaluate or measure the services rendered to individuals and societies by doctors, lawyers, social workers, and ministers? The more the services of these professionals have been deprofessionalized from the traditional sense

of profession and marketed in the traditional sense of business (such as selling soap or repairing televisions), the easier it is to subject them to conventional economic analysis. Inherent in the traditional notion of profession is public and civic service, special learning, and high standards of ethical conduct. Thus, it used to be more important for a doctor or lawyer to save a life than make a fee, for a minister to ". . . save a soul" than to be highly paid. Advertising or special merchandising of the services of either in the past would have been regarded as unprofessional, vulgar, and corrupting. Although technical efficiency has always been important for the professions, economic efficiency has not. Higher education as an activity which provides services, say, to production may in part be regarded as the traditional professions were conventionally regarded. If so, it would be inappropriate to subject it to traditional or even modern economical analysis.

But alas, just as medicine and law are going more and more commercial and, thus, are inviting conventional economic analysis, management, and profiteering, so higher education may be going. Indeed, much of student unrest is a counter-revolution to what Jencks and Riesman call the "academic revolution."[12] In discussing this problem in another context I have said:

> Students . . . seeking relevancy between knowledge and action, learning and life, instead find "pedantry and alienated erudition," research grantsmanship and academic arrogance. Faculty members make more and teach less; work shorter hours and take longer leaves; obtain rank from universities and pull rank on students; and last but not least, they seek tenure and avoid students.[13]

I suppose it is difficult for higher education, just as for other institutions and professions, to resist the inexorable forces of an urban-industrial society. To the extent higher education can avoid being just another economic entity it can invite standards of traditional, qualitative evaluation rather than economic quantification.

Education Increases Productivity

There seems to be much evidence that the instruction students receive in higher education, both graduate and undergraduate, greatly increases their productivity as workers in the economy. Although economic studies may be engaging in the fallacy of confusing *post hoc* with *propter hoc,* all that is necessary to measure higher education productivity is to obtain statistics on the life-earnings of workers who have pursued post-high school education and those who have not. I think it is fair to say that the identified greater income of those who have attended higher educational institutions is correlated to their higher productivity than to those who have not attended higher educational institutions.[14]

The talent hunt aspect of higher education has been woefully neglected. There is no question that higher education plays a great role in providing students with an opportunity to discover whether they have the particular capabilities that are required for performing whatever work, vocation, or occupation they have chosen. I suspect that the greatest contribution higher education makes in the talent hunt aspect of our economy is that attendance and completion of post-high school educational institution demonstrate a kind of self-discipline and self-determination which are valuable assets in workers in almost any kind of economic enterprise.

Related to this function of discovering talent in higher education is the problem of inadequacy of counseling, both vocational and psychological, in high school and post-high school institutions. Adequate counseling in high school should help a student tentatively, not only to determine for himself, his career or vocational choice, but also, more importantly, to select the post-high school institution or environment in which his capacities and aspirations will be nurtured best. As a result of visiting a few highly selective and elitist liberal arts colleges and talking to even more highly motivated and skilled students, I am of the opinion that a number of post-modern youth are more interested in transforming colleges and universities into communes, encounter groups, and scenes for group therapy than in pursuing traditional higher education in its various forms of classical, scholarly, community and research-oriented institutions. This is not to malign these commendable searches for self-expression, improvization, sincerity, identity, and authentic community. I just wonder whether higher education institutions are the proper environment for such pursuits.

Although the research-service function of higher education may sometimes be exaggerated, there is no question that the organized agricultural research of land-grant universities had a tremendous payoff in terms of the development of agricultural productivity and efficiency. The land-grant movement is one of the great success stories in higher education and you might say social legislation in the history of the United States. Unfortunately, no adequate research has been done or studies made of the actual impact of organized university research on other aspects of the economy. One can safely assume that it has had some substantial posi-

tive impact, but it is not altogether clear whether a comparable impact could have been derived more economically from a greater expansion of research and development by private corporations or special research institutes like the Rand Corporation. Corporations like Rand may be on the wave of the future. Certainly, many have already developed; if universities continue to be agitated by confrontations and disruptions, many more research scholars will repair to these research institutes. Research apparently has been separated from talent hunt and training in Russia for some time without any noticeable adverse effects upon research.

Enclaves Are Undesirable

This last observation leads me to make a comment on the research activities of the universities which could more logically be left for my discussion of politics and culture. Here, however, logic may do violence to common sense. A recent article by Caryl P. Haskins in *The American Scientist,* entitled, "The Humanities and the Natural Sciences,"[15] suggests that there may be grave risks run by society or the public sector if research or investigational *enclaves* are separated from universities and thus separated from meaningful and vital association with the humanities and soft social sciences. After surveying the many fantastic advances in science, particularly the probability that genetic change can be controlled, Haskins asks for what purpose or toward what end. He answers this question with the observation, "It is the humanist, it seems to me, who must be prepared to provide the vital contributions here."[16]

Surprisingly, many of the advances in science which Haskins speaks about took place in what he called investigational *enclaves,* " . . . an environment shielded, at least in good part, from the windier currents of the world, the inherent right and duty of those comprising it to preserve a working climate effectively, and where necessary vigorously, protected against demands of the wider world for immediate and short range return."[17] Haskins believes that the humanities and I suppose, also, the social sciences are especially concerned with the doctrine of the final worth and sacredness of the individual and the doctrine of the extraordinary importance of the life of the mind in our society.

The matter of an investigational *enclave* is especially important. Research institutes can partially meet this need, but I believe, for the humanizing purposes Haskins speaks of, it will be necessary to insure that a significant number of these *enclaves* stay at the great universities. For example, the head of the Economics Department of the Rand Corporation recently led a discussion at the Center for the Study of Democratic Institutions on the military-industrial complex. It was one of the most frightening discussions I have ever heard.

Simply put, he tried to suggest that all or, at least, most of the criticisms made of the military-industrial complex in terms of secrecy, complexity, institutional rigidity, scale, *et cetera,* could also be made of the health-educational complex. The kind of rigorous technical analysis he brought to bear on the military-industrial and health-educational complexities, as he called them, can be useful — especially as an intellectual and chastening exercise. However, when he, with self-satisfaction in his oral presentation, indicated that in terms of uninflated dollars the military budget had increased only ten billion dollars between 1961 and 1971, while the health and education budget increased from 2 to 22 billion dollars in the same period, I almost blew my top. I am afraid that many of the criticisms made of Rand are justified. These crucial matters seem nothing but a numbers game to them. They talk about allocation of resources for warfare and killing as if they were indistinguishable from or comparable to the allocation of resources for health and education. The humanities do have an important role to play, which they can only play in relation to scientific and technical research, if they are both part of a common community such as a university.

Much more could be said about the contributions research activities at universities make to our economy and society. I think this matter of research institutes being isolated from society and economic analysis, abstracting and computerizing with numbers and digits vital social processes, leads to a discussion of the importance of the political contribution of higher educational institutions to society.

Students React to Technology

However, before leaving a discussion of the economic impact of higher education, a word or two should be said about students' reactions to economizing and computerizing life and about the consumption function of education. Michel Crozier, in a brilliant article[18] describing his impression of America upon revisiting it, noted great changes and the fact that, with the exception of Spain of all Western nations, America has had the most bloody past. He observed about the Eisenhower years, "It was natural for America to be conservative, to have lost confidence in its creative ability,

to seek refuge in a ponderous moral complacency, showing beneath its hypocrisy an inferiority complex toward communism and even toward Europe." This complacent and conservative prosperity was followed by a period of " . . . aggressive confidence in human reason and the capacity of America to solve all problems by its use." PPBSs, computers, and other instruments of technocrats inspired an " . . . arrogant pride in the powers of reason" which both blacks and post-modern students were reacting to, although for different reasons. The former are in revoit, according to Crozier, because they have found their civil rights gains valueless since they can be capitalized upon " . . . only through the ability to play the game of modern calculation . . . . The more rational the society becomes, the more he loses his foothold. His emancipation is of no use to him, because he is much less competitive in today's society than he was in the traditional industrial society." I suppose one might infer from this analysis that this situation and predicament encourage blacks to engage in tactics of bombast, militancy, and hyperbole. He concludes about blacks that the apocalyptic aura should not hide the basic fact that " . . . their problem stems from the intellectual change, not from a will to seize power."

On the other hand, students are in revolt because they are fascinated with the system and its rationale but, yet, they find no respite or secret corner hidden from the technological juggernaut. Thus, students are " . . . dedicated to the cult of passivity and drugs, to living in happy abandon, to the refusal to shoulder the burden of calculation and responsibility." There emerges and endures a conflict between " . . . the rational and the spontaneous, the community and the individual, the desire for freedom and the fear of responsibility." Crozier's answer or advice is:

> Perhaps, in order to carry the debate further, Americans will have to abandon this insoluble riddle and re-examine, through their institutions, the minimal degree of anarchy, confusion, and inefficiency which must be tolerated if the participants are to withstand the rigors of the new rationality.

Although higher educational environments at many schools reinforce or even encourage such a reaction to reason, I believe this reaction is as much a product of student inputs — talents, skills, aspirations, affluent backgrounds — as it is the impact of higher education upon students. Post-modern white youth are in the midst of psycho-cultural revolution and are not preoccupied with "making it." Indeed, they are not sure "making it" is worth the effort.

Crozier's analysis of the malaise of blacks has enough validity to give it some credibility. However, appeals to catastrophe are inspired more by knowledge and experience of unspeakable atrocities visited upon blacks than by insecurity and uneasiness with calculation, responsibility, and techno-industrial rationality. After all, the Kerner Report emphasized the overriding importance of racism in explaining the predicament of blacks in America, and the authors of that report suffer neither from an inability to play the game of calculation nor from paranoia or apocalyptic obsessions.

The consumption function of higher education is related to the activities of students and the campus community which involve consumption of goods and services of the economy or to the development of tastes, sensitivities, and opportunities which lead to life styles of consumption by students on a long range basis. This is closely related to the cultural impact of higher education upon students. As it will be briefly indicated later, this function of higher education is in competition with mass media, particularly television.

Political Impact

The political impact of higher education may be approached by way of Dr. Kerr's notion of the citizenship function of higher education.[19] Now the citizenship function is a function that's very important. Here we are talking about those activities which " . . . relate to the performance of students, alumni, and faculty members in relation to civic responsibilities." It is carried out in a number of ways. One way, I suppose rejected by many, is completing students' socialization. This is resisted by some and criticized by many. Certainly it is criticized by radical students and academicians. They feel that universities are too much involved in the process of socialization, that they are trying to train students to accept society as it is, and that the universities are *status quo* oriented and implicated.

However, I think it is sometimes forgotten in criticizing the socialization function which higher education sometimes contributes to, that no society can exist without a measure of order. Here you see creeping through my own special concern for law and order.

The public sector should be especially interested in citizenship. If educational institutions in our democratic society do not teach students about the American heritage of freedom (I have a little trouble saying, "heritage of freedom"; I haven't had it, but many whites have), then how will citizens develop a deep understanding and appreciation of it. I see nothing wrong with educational institutions trying to communicate to their student

clientele a heritage of freedom and to teach something about the constitution, something about what democracy means, something about the complexity of social order and the fact that there is a need for people to make some adjustment to each other and even to society. Although socialization may be contrary to an ideology of self-expression and spontaneity, if every individual were to pursue his own thing, oblivious of other people's things, society would run into intolerable conflict and chaos. This is not to say that one cannot do his own thing. I believe very much in one's doing one's own thing, but within a framework of social order.

Preservation of Social Democracy

Professor Jill Conway, in a recent article entitled, "Styles of Academic Culture,"[20] suggests that the main social function of education, particularly universal education, is " . . . the preservation of social democracy" in America. She observes that John Dewey diagnosed the problem of public education as not having " . . . functioned as an agent of democracy in America, because it had taught the literary and aesthetic values of a European aristocracy."[21] The public education curriculum was redesigned in response to this criticism and the land-grant movement in state higher education had already inaugurated vocational training and community-service activities. This political or social function of higher education has created the expectations and circumstances which have given rise to some of the disenchantment with higher education already mentioned. Professor Conway says:

> Because of the mythic dimensions of the school as custodian of the democratic future, the educational community is automatically perceived in America as the community that can resolve all social problems

Professor George Kateb, in a useful but curiously critical review of several books on education, put the same matter as follows:

> How can the academy endure the strain of being mother and father, leader and victim, asylum and enemy, playground and hospital, healer and criminal, reformer and delinquent, church and state? Everything is expected of it, nothing is forgiven it.[22]

I believe these high expectations regarding higher education are the results of its former successes, particularly its performance in the land-grant university development. Yet the universities seem to be failing miserably in their socialization function, if socialization is defined merely as adjustment to the existential social order. This naturally leads to a discussion of the critical evaluation service of the citizenship function of higher education. However, before turning to this service or output of higher education, I should like to refer to an article which mixes political and economic considerations in appraising higher education.

Higher Education as a Form of Industrial Apprenticeship

Christopher Lasch and Eugene Genovese in a recent article entitled, "The Education and the University We Need Now,"[23] state that neocapitalism must exclude large groups from production because they are economically superfluous — they must be kept in places of detention. Blacks, the new poor, young people, and women constitute the large groups which need to be excluded, according to Lasch and Genovese. This crypto-Marxist political-economical analysis is worth further elaborating because it is strewn with evocative insights and elitist humanism.

They continue their analysis by ironically observing:

> . . . the gradual achievement of universal education, like many other reforms that appear now only to have hastened the coming of the "technotronic society," was wrested from the ruling class in the face of determined opposition.[24]

Furthermore, the tendency of education since the seventeenth century has been to make schools into total educational environments whereas the medieval concept of education viewed the pupil as free of supervision outside school hours. *In loco parentis* developed with residential colleges which supervised all aspects of students' lives. Young people became segregated in a prolonged state of adolescence — a state of dependence and subordination. Young people of the twentieth century have been glorified in a manner similar to the glorification of womanhood in the nineteenth century in order, cynically to keep women in a subordinate position, " . . . but which many women internalized, just as many young people internalize the glorification of youth and remain permanently adolescents, emotionally, intellectually, and — not least — politically." Bourgeois society can solve problems of youth no better than other problems with which it is faced. Neocapitalism cannot solve them without committing suicide, say Lasch and Genovese, to:

> . . . destroy the custodial function of schools; dissociate education from the process of providing qualifications for work, so far as this is possible, and where it is not, recognize more frankly the character of education as apprenticeship while seeking to improve apprenticeship itself; and finally, providing acceptable alternatives to formal schooling, both for young people and — equally important — for adults.

They suggest a partial solution is to shift technical training to secondary schools and, thus, release the university from its custodial responsibilities. Of course, I would observe that the custodial responsibility logically is urelated to the matter of the nature or place of schooling, for that matter schooling or training at all.

They further support the earlier stated notion that there is no correlation between education and industrial efficiency. Credentials are more important in getting jobs than in actually performing them. Yet, somewhat inconsistently, they argue that the most striking function of higher education apart from the custodial function is training an army of intellectual workers on which the corporate system depends. *"Higher education has become another form of industrial apprenticeship."*[25]

This makes higher education " . . . another form of production." Thus the ruling class wants higher education, like secondary education, to:

1) *train competent intellectual workers,*
2) *find compensation for powerlessness in a culture of consumption,* and
3) *mind their own business in matters of state.*

In short, Lasch and Genovese see higher education as producing intellectual proletarians.

The first comment I should like to make upon the above analysis is that it appears to criticize higher education for performing too well the service of discovering talent and training workers for the economy. From an economic viewpoint Dr. Schultz would flatly challenge the suggestion that it is wrong for higher education to serve society and the economy the way secondary education has served them. In fact, he indicates that the private rate of return on secondary education when education is viewed as an investment in human capital is nearly twice that of college graduates.[26] The non-pecuniary returns are more difficult to calculate.

Second, when assessing non-pecuniary returns of higher education, there is much evidence that higher education is failing miserably, at least at the most prestigious and so-called distinguished universities, in compensating students for their powerlessness in a culture of consumption and in inducing students to mind their own business in matters of state. I had thought students have been in the vanguard of the Civil Rights, the Peace, and now the Ecology Movements. True, a fringe of post-modern youth, ironically called the counter-culture movement in its effort to avoid co-optation by a technocracy of hyper-consumerism, has opted for a flight from politics to poetry and from rational persuasion to spiritual conversion.[27] This may be a good place to turn to a discussion of the critical-evaluation service or aspect, process, and output of the citizenship function of higher education.

Preparation for Social, Political Conflict

The critical-evaluation aspect of the citizenship function of a university results in a tension between this aspect and the socialization aspect. Here the university must carry out an operation similar to that which Roscoe Pound spoke of regarding law; that is, it must nurture stability and yet not stand still.

A most eloquent and responsible spokesman for the critical and evaluation function of higher education is Robert M. Hutchins, former President of the University of Chicago.[28] Although he was a revolutionary innovator in higher education, he did not think society would tolerate a revolutionary educational system; still he thought one of man's missions on earth was to change his environment which is inconsistent to a large extent with the socializing aspect or process of higher education. Thus, I would suppose he would say that the proper concept of a university is that it is an intellectual community and an independent center for the pursuit of truth. This will require critical discussion, questioning, and debate of everything from the microbe and the molecule, to man and society, to nations and the world, and to the world and the universe.

Many modern radicals would regard President Hutchins' critical discussion, questioning, and debate innocuous, gutless, and escapist — if not an elegant cop-out. Criticism and evaluation, to them, are only important when they reach the level of agitated dissent which calls for direct action and involvement in society. The direct action and involvement must be comparable to the intensity of their indignation and outrage and which are stimulated by their unshakable judgment and perception of the present social order as being irredeemably corrupt and violent. Their critical and, in many respects, sound perception of, say, the United States as a hypocritical, callous, racist, and violent society leads them to question its legitimacy. Repressive over-reactions to their confrontations, demonstrations, and protests have contributed to a widespread conviction among many of them that, to quote Friedenberg, "They are oppressed by a fundamentally illegitimate authority."[29] They react to their perception of the illegitimacy of their repressors somewhat in the way Dostoevski's hero

reacted to the presumption of God's non-existence: Then everything is permitted.

Students Reject Hypocrisy

With all of my deep sympathy for the post-modern youth's emphasis upon *style,* action, and process rather than ideology; upon the *credibility gap* with its dishonesty and its separation of principle and action; and upon their fixation upon *violence,* with them rejecting and projecting and electing it — I do not and cannot accept the proposition that perception of illegitimacy or any other evil permits any and all types of action against it. What they have done is reject hypocrisy and replace it with their own elitist self-righteousness.

Now Nathan Glazer[30] has suggested three possible political stances a university can take vis-a-vis society. One, that it can educate its students and prepare them to act in society. Two, that it can encourage students to participate actively in the reform of society. Three, that it can engage itself in the radical reform of society by becoming a revolutionary university or partisan camp. I think it's obvious that if a university becomes revolutionary it will not survive. Certainly, the public sector has no obligation to support or encourage the existence of a revolutionary university.

I hope the above discussion will not be interpreted as meaning I believe that higher education, through its students, research, community involvement or other activities, should not make waves. Quite the contrary. Yet, it should not be insensitive to the sensibilities and concerns of the public sector. Perhaps it would be helpful if I interjected here my personal concept of education. I believe education is essentially an intellectual process which requires the imaginative and creative development of the mind, the continual enrichment of human sensitivity and sensibility, and the purposeful pursuit of an understanding of the relationships between man and man and man and nature. Obviously this conception of education would constrain me to believe that higher education not only should prepare students for political and social activity and involvement but also should encourage such activity and involvement.

I like S. E. and Zella Luria's[31] discussion of the role of the university. The authors pose three key alternatives for a university:

1. Accept predominant values of and identify with society.
2. Reject society's values and withdraw into traditional ivory tower.
3. Develop a critical creative relationship with society.

They opt for the third alternative. I would add that there should be enough leeway and pluralism in higher education to tolerate or permit different universities to opt for any one of the three alternatives. This may appear muddleheaded. I suppose it is. I would add that I think an undergraduate school would serve society better if it chose the third alternative; a graduate school, in some respects, could better pursue the second alternative; and university extension services or social involvement logically could pursue the first alternative. The research activities of university could pursue all, any one, or any combination of the alternatives. I certainly agree with the Lurias when they said, "In our society, the university may be the most effective structure through which intellectual forces can be put to use in influencing the course of social evolution in a rational way."[32] This may be as good a place as any to turn to a discussion of the cultural impact of higher education.

Cultural Impact

Thus far we have been discussing higher educational impacts upon aspects of the social order which are peculiarly congenial to a public sector viewpoint and appraisal, although the appraisal cannot be made with scientific rigor. If for no other reason than that it is paying a large part of the bill of higher education, the public sector is interested in a certain measure of economy or economic efficiency in the various aspects, processes, and products or outputs of higher education. Yet, historically, the motive force of public higher education has been as politically determined as economically determined — preservation of social democracy. Of course, the pragmatic spirit of Americans quickly recognized the economic benefits of a well-trained labor force and of technological progress supported or stimulated by university-based research and extension or community services.

The public considering in tandem the economic and political benefits of higher education has served well, what Dr. Trow calls, the popular functions of higher education, " . . . those activities and purposes that the university . . . takes on in response to external needs and demands."[33] It is very fortunate for higher education and America that, initially, private education dominated higher

education and afforded it an opportunity to develop a tradition of intrinsic functions, or at least functions which were not dependent upon any externally imposed popular consensus which could easily have been too short-range in its view. That the populist land-grant college movement was so successful does not detract from the value and importance of what Dr. Trow calls the "autonomous functions" of higher education, ". . . activities and purposes that the university defines for itself." Indeed, too strict an economic analysis of higher education either internally or externally would probably be very unwise for society in the long run and disastrous for higher education in both the short and long run. Although education has been a most powerful and effective servant of economic processes, it is not essentially an economic process itself. Unfortunately, economic progress like technological development tends to swallow up the ends and values it is supposed to serve. Thus, not only are the time, land, capital, and labor devoted to education regarded strictly and almost solely as commodities to be measured in dollars and valued in an economic calculus, but also are the educational process and products so regarded.

Dominant Thrust

This latter thinking, which seems to be the dominant thrust of educational policy in the Nixon administration,[34] may lead to a kind of educational open market and entrepreneurship which would be disastrous for the intrinsic and, I believe, cultural values of higher education. Of course, the policy of an open educational market is supposedly humanized or democratized by an elaborate and expansive educational loan program. Thus, all prospective students would have or be loaned enough money to attend college, and the various universities and colleges would compete like soap, clothes, and food producers for their patronage. Madison Avenue would then have to take over the merchandising and packaging if not the processing of higher education.

Michael Clurman in a recent article[35] condemns the dual price system of public and private education and the subsidization of institutions; however, he lauds the market and its functions and urges subjection of higher education to the price system by charging full-cost tuition fee with government providing modest grants, liberal loans, and a universal repayment system through taxes. This is his position, although earlier in the article he said that higher education's financial problem was not general poverty as a whole, but " . . . the intense competition for academic prestige and distinction among the various colleges and universities which accounts for the financial insecurity experienced by so many institutions of higher learning."[36] In other words, the cure for the ills caused by intense competition is more competition under the benevolent aegis of the invisible hand of the price system.

Surely, the cultural impact of higher education has been very great upon its outputs. This is so not so much in terms of higher education transmitting high culture which traditionally has been one of its autonomous functions but in terms of cultivating " . . . aesthetic sensibilities, broad human sympathies, and the capacity for critical and independent judgment."[37] This fact goes a long way in explaining the radical discontent of so many of the good students at not only the so-called best educational institutions, but also the less famous and prestigious institutions. What has happened is that this generation of college students, less preoccupied with personal welfare or vocational success than prior generations, sees the great potential for the realization of the American Dream for all and yet finds the country wasting its youth and resources in a violent and obscene assault upon the land and people of Southeast Asia; spending billions to send men to the Moon, but balking at the expenditure of a few million dollars to clear ghettos of rats; destroying its environment; refusing to do justice to blacks and other underprivileged groups. As I have said before, "It is in large measure because universities and colleges are supplying youth with a superior education that they perceive more clearly than past generations the stark contradiction between what is preached and what is practiced . . . "[38] by this country. If the economic and political institutions of this country do not become more responsive to many of the grievances the post-modern youth have dramatized, then it is on a collision course with disaster.

More Conscious Than Before

This is so because the middle-aged generation, by virtue of its reasonably good education, is more conscious than earlier generations of problems and society's capabilities to cure them. It is just a little less sensitive and more tolerant of problems than post-modern youth. Furthermore, in part, because of the glorification of youth already referred to, adults now learn from and mimic their children — a phenomenon Margaret Mead characterizes as a pattern of a *prefigurative* culture.[39] She states that there are three dominant patterns

of transmitting identity and commitment: 1) *postfigurative* where children learn primarily from their forebears; 2) *cofigurative* where both children and adults learn from their peers; and 3) *prefigurative* where adults also learn from their children.

The postal strike ought to have told somebody something!

The greater consciousness of middle-aged and young people is evidenced by what David Riesman characterizes as " . . . an atmosphere of . . . extravagant self-criticism (which) . . . has succeeded an earlier tendency toward glib self-satisfaction."[40] I should think a major measure of the cultural impact of higher education is the extent of self-criticism and self-consciousness of its products. Of course, problems and adversities may become so pervasive and intractable that the consciousness is numbed or the problems filtered out in self-defense. Of course, these observations have less validity for students and young people who are seeking social mobility and economic security.

Higher education in the years to come will be in great competition with mass media in molding the culture of the country. With higher education approaching meaningfully open access, if not universal attendance, there are good reasons for projecting it as playing the predominant role in culture molding. This may not be a gain, at least not from the educators' perspective, if Madison Avenue and Wall Street take over the educational "enterprise."

Conclusion

Higher education has had a tremendously positive impact upon our economy, most demonstrably the agricultural economy. People who have attended or graduated from college generally earn more than those who have not, which permits the reasonable inference that higher education increases the economic productivity of its student output. Generally, it should have been surmised, the more years of higher education one has completed, the greater his lifetime earnings and income. (Some crafts protected by trade unions would make one wonder about this.) Of course, with the present eco-talk about the quality of life, one might further surmise that the highly educated are more conscious of cultural and life-quality possibilities in society, and thus may be comparatively unhappy and vice versa for the less educated(?).

Higher education has performed reasonably well its function of discovering talent, training or instructing workers, and expanding knowledge through research — all to the benefit of the economy. Research and community (or extension) services have been spectacularly successful in agriculture. It should be added that research in the medical and biological sciences has been equally successful in advancing health science and even health technology, narrowly defined, but an increasingly disgraceful failure in delivering economical health services to society in general. The deficiency here is, in large measure, the fault of the organized medical profession. Its reactionary politics has obstructed public health care and insurance programs. Its self-serving guild entropism has discouraged, until very recently, increasing the number of trained health specialists. The political practices of any given profession or pressure group complicate any evaluation of higher education's outputs or impact upon the profession or group and those publics which the profession or group serves.

A gross way of measuring the effectiveness of higher education may be to determine how well off a particular aspect of the public is which is principally served by the products of higher education, be they workers; research for social, economic, or technological development; or community or extension services. Of course, this obvious and somewhat simple method of evaluation can create a vicious cycle by imposing and reinforcing unreasonable and unreasonably high expectations upon higher education. Even so, in spite of Vietnam, the developing medical services crisis, ecological apprehensions, deep pockets of poverty, and scarcely abated racism, one could say, as Dr. Clark Kerr has said, "Higher education in the United States is at the pinnacle of its effectiveness."[41]

However, because of the "collision course" discussed briefly in the early part of this paper Dr. Kerr follows the above quoted statement with, "It is also more beset with more fundamental problems than ever before in its history." But even these fundamental problems, which I do not think create as much of a crisis as many educators contend, are more the product of unreasonably high expectations created by higher education's past successes than the many deficiencies which are in higher education itself. In truth, higher education's biggest problem is the adult backlash to postmodern youth protests, demonstrations, and confrontations. The latter are the product of student discontents which in substantial measure flow from the effectiveness and the high quality performance of higher education in its political and cultural impact upon students. Putting the problem of providing better health services and greater equality

of educational opportunity aside, higher education's biggest problem has been its great success in elevating student consciousness and sensibility and providing the science and knowledge explosion for the military-industrial-technological juggernaut.

1. For example, in 1958 federal support for higher education institutions was $750 million. However, ten years later it had increased over six-fold up to $4,700 million in 1968.

2. David Riesman, "The Collision Course of Higher Education," *The Journal of College Student Personnel* 363 (November 1969).

3. Howard R. Bowen, *The Finance of Higher Education,* 5, (Carnegie Commission, 1968). Dr. Bowen defines economic cost as follows:

> The *economic cost,* on the other hand, reflects the true cost to the student (or to society) of his attending college. It includes the expenses incident to education such as books, supplies, transportation, etc. It also includes any expense for board and room, clothing, and other living costs over and above what would have been required had he not attended college. Finally, and most important, it includes the loss of earnings to the student because he has chosen not to be in the labor force.

4. *Id.* at 7.

5. *Change in Higher Education* 2 (March-April 1970).

6. Trow, in *Daedalus: The Embattled University* 99 (Winter 1970): 1.

7. *Id.* at 24.

8. *A Chance to Learn: An Action Agenda for Equal Opportunity in Higher Education,* A Special Report and Recommendations by The Carnegie Commission on Higher Education (March 1970).

9. *Id.* at 11.

10. Clark Kerr, *The Pluralistic University in the Pluralistic Society,* in THE GREAT IDEAS TODAY (1969); Theodore W. Schultz, *Resources for Higher Education: An Economist's View,* reprinted from The Journal of Political Economy 76 (May/June 1968) Carnegie Commission on Higher Education, 1969.

11. Schultz, at 329.

12. Jencks and Riesman, *The Academic Revolution* (1968).

13. Tollett, "The Governance of a University in a Democratic Society: Random Reflections Upon Participatory Politics, Black Power, and Law and Order," in *Inaugural Proceedings, Wright State University* 33 (Dayton, Ohio 1969).

14. "Income statistics suggest something of the personal economic value of a college degree today. In 1968, the median annual income of heads of households who completed four or more years of college was $12,288; for those with one to three years of college, it was $9,485; and for high school graduates, $8,583." *Current Reading,* The Public Interest No. 19, 133 (Spring 1970).

15. Caryl P. Haskins, "The Humanities and the Natural Sciences," *American Scientist* 23 (January-February 1970) :58.

16. *Id.* at 28.

17. *Ibid.*

18. "The Lonely Frontier of Reason," *The Nation,* May 27, 1968.

19. Kerr, at 23.

20. Conway, "Styles of Academic Culture," in *Daedalus: The Embattled University* 99 (Winter 1970) :43.

21. *Id.* at 44.

22. George Kateb, "The Campus and Its Critics," *Commentary* 47 (April 1969) :40-41.

23. *The New York Review of Books* 13, October 9, 1969.

24. *Ibid.*

25. *Id.,* at 22 (emphasis added).

26. Schultz, at 337, writes: "We need to remind ourselves that there are still some children who are not completing the elementary grades; and what is more important is the underinvestment in the quality of elementary schooling, especially in many rural areas . . . (T)he private rates of return to white males after personal taxes in 1958, are 28 per cent for high school graduates and 14.8 per cent for college graduates."

27. Theodore Roszak, *The Making of a Counter Culture* (1970).

28. Hutchins, *The Democratic Dilemma,* The Gottesman Lectures, Uppsala University, (Stockholm, Sweden, 1951).

29. Friedenberg, "Legitimate Violence," *The Nation* 206, (June 24, 1968): 822.

30. Glazer, "Student Politics in a Democratic Society," *The American Scholar* 36, (Spring, 1967).

31. "The Role of the University: Ivory Tower, Service Station, or Frontier Post?" *Daedalus: The Embattled University* 99 (Winter 1970) :75.

32. *Id.* at 83.

Of course it is important to heed the warning of John H. Schaar and Sheldon S. Wolin that higher education must avoid the "deeper retreat into the sanctuary of ingeniously obscure research" — while mumbling incantations about higher values. "Education and the Technological Society," *The New York Review of Books* 13 (October 9, 1969) :3.

33. Trow, *supra* note 6, at 2.

34. *The Chronicle of Higher Education,* March 9, 1970, on page 3 reported discussion of financing higher education. It indicated that in the past President Nixon applauded a full-cost tuition, long-term loan, open market approach to higher education. Howard R. Bowen, President of Claremont University Center, stated that such an approach would make colleges and universities subservient to every whim of the customers. "Moreover," he said, "at a time when we are trying to bring millions of minority and poor people into the mainstream of American society, it would seem perverse to raise the price of higher education and to offer it only to those willing to go heavily into debt."

Mr. Bowen advocated instead relatively low tuitions " . . . veering toward the free-public-education model rather than the full-cost model."

35. "How Shall We Finance Higher Education?" *The Public Interest* (Spring 1970) :98.

36. *Id.,* at 100.

37. *Ibid.*

38. *Supra,* note 13, at 34.

39. Mead, "Youth Revolt: The Future is Now," *Saturday Review* 53, (January 10, 1970).

40. Riesman, " 'The Lonely Crowd' 20 Years After," *Encounter* 33, (October 1969).

41. Kerr, *New Challenges to the College and University* (Carnegie Commission on Higher Education, 1969).

SOME APPROACHES TO MEASUREMENT

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"Student outputs would include measures of the student's achievements, knowledge, skills, values, attitudes, aspirations, interests, daily activities, and contributions to society."
"Student inputs are the talents, skills, aspirations, and other potentials for growth and learning that a new student brings with him to college. These inputs are, in a sense, the raw materials with which the institution has to work."

"The college environment refers to any aspect of the higher educational institution that is capable of affecting student outputs. Broadly speaking, the term includes variables such as administrative policies and practices, peer associations, and other attributes of the college experience that might affect the student's development."

"No management information system is of much use unless the causal connections between environmental variables and output variables are known."

Measuring Student Outputs in Higher Education

ALEXANDER W. ASTIN

Any consideration of how best to measure the outputs of higher education necessarily requires that one clarify just what is meant by "outputs." For the purposes of this paper, I shall use a conceptualization of student outputs that has characterized recent longitudinal research on the impact of colleges on their students (Astin, 1970). While this view may be foreign to some readers, particularly to those whose backgrounds are in economics or related fields, I believe that it is useful in elucidating certain basic issues which might otherwise be overlooked.

The System of Higher Education

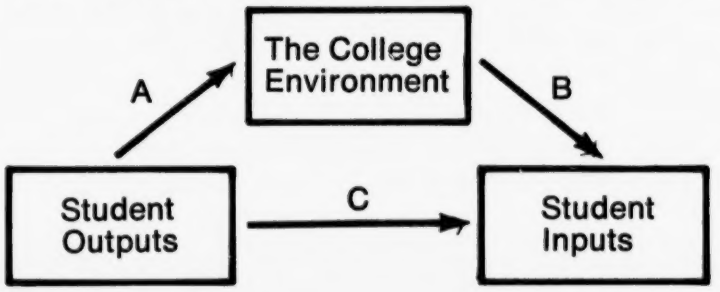
Briefly, in this view, the process of higher education is regarded as comprising three conceptually distinct components: *student outputs, student inputs,* and the *college environment.* Student *outputs* refer to those aspects of the student's development that the college either influences or attempts to influence. Although these outputs can be expressed at very high levels of abstraction (for example, " . . . the ultimate happiness and well-being of the individual"), we shall limit our consideration of the problem to those relatively immediate outputs that can be operationalized. Specifically, then, student *outputs* would include measures of the student's achievements, knowledge, skills, values, attitudes, aspirations, interests, daily activities, and contributions to society. Other terms that are sometimes used to refer to student outputs are dependent variables, criterion variables, outcome variables, and educational objectives.

Student *inputs* are the talents, skills, aspirations, and other potentials for growth and learning that the new student brings with him to college. These inputs are, in a sense, the raw materials with which the institution has to work. Some inputs may be simply "pretests" on certain student outputs (scores on college admissions tests, for example), while others (sex and race, for example) may be relatively static personal attributes. Inputs can affect the outputs either directly or through interaction with environmental variables (below). It should be pointed out that economists and others interested in systems analysis or management information systems typically use the term "input" in a much broader sense than the one proposed here. Usually, this broader use includes what I have termed environmental variables (below) as well as student inputs. In assessing the outputs of higher educational institutions, however, it is useful, if not essential, to differentiate conceptually and operationally between measures of student inputs and measures of the college environment.

The *college environment* refers to any aspect of the higher educational institution that is capable of affecting student outputs. Broadly speaking, the term includes variables such as administrative policies and practices, curriculum, faculty, physical plant and facilities, teaching practices, peer associations, and other attributes of the college experience that might affect the student's development. These environmental variables can, presumably, be changed or manipulated through reallocation of resources.

The relationships among the three components of the model are shown schematically in Figure 1. Note that student outputs can be affected by both environmental variables (Arrow B) and student input variables (Arrow C). Moreover, as Arrow A indicates, college environments can be affected by the kinds of students who enroll. In addition to these "main" effects of environments and inputs on outputs, there may be *interaction* effects involving student inputs and college environments. As the diagram suggests, there are two types in interaction effects: those in which the effect of input on output is different in different college environments (AC), and those in which the effect of the college environment is different for different types of students (AB).

FIGURE 1.
THE THREE COMPONENTS OF THE MODEL



The matter of assessing the outputs of higher education involves two basic problems. The first is that of defining and measuring the relevant output variables; this will be the main subject of this paper. The second, closely related, task is that of determining the *effects* of environmental and student output variables. This latter problem, which involves primarily experimental design and statistical methodolgy, is dealt with at length in another paper (Astin, 1970). Suffice it to say that, no matter how elegantly or appropriately the output variables are measured, no management information system is of much use unless the *causal* connections between environmental variables and output variables are known. In order to make trustworthy judgments about these causal relationships, it is necessary first to conduct longitudinal studies that incorporate data on student inputs, student outputs, and college environmental characteristics (Astin & Panos, 1970).

Conceptual Outputs and Output Measures

The measurement of any educational output ordinarily begins with a statement about some aspect of the student's development that is considered desirable or important. This verbal statement, or *conceptual output*, originates in the value system of the person making the statement. The task in developing an appropriate *output measure* is to operationalize this conceptual output in some way (Astin, 1964). The process of operationalizing typically involves collecting empirical data which are judged to be relevant to the conceptual output. In some instances, the raw data already takes the form of a "measure" (dropping out versus staying in college, for example), whereas in others, the raw data must be combined or manipulated in some way in order to derive the final measure (answers to multiple-choice questions on an achievement test, for example).

In attempting to "evaluate" an output measure, or set of measures, one must keep in mind the distinction between conceptual outputs and output measures. The appropriateness of any empirical measure can be judged only in terms of its apparent relevance to the conceptual output. In contrast, the conceptual criterion itself — being derived basically from value judgments — is not subject to the same sort of analysis.

Although we cannot differentiate operationally between the conceptual output and the output measure, the construct of *conceptual output* is important for at least two reasons. First, the relevance of any output measure and the rationale for its being selected are better understood if the conceptual stage is documented. Second, because the conceptual output often implies something more than the actual output measure, it may prove to be a valuable source either of future output measures or of improvements in existing ones.

Single or Multiple Measures?

Any discussion of the measurement of educational outputs must give some attention to the question of using multiple measures versus a single, "overall" measure of educational progress. Although a single output measure possesses certain obvious advantages because of its conceptual simplicity and computational convenience, it is unrealistic as well as misleading to reduce college impact to a single output measure. Therefore, in discussing the various problems associated with measuring student outputs, I have assumed that there are many outcomes, both planned and unplanned, which must be measured if an adequate and useful assessment of institutional impact is to be carried out. This assumption is based on a belief that even within a relatively homogeneous group of undergraduates, individuals can vary greatly in the importance they attach to any given educational outcome. Accordingly, this paper will not treat the problem of assigning relative weights to various alternative outcomes. Subjective weighting in terms of degree of "importance" requires value judgments that are more appropriately the province of the students, educators, planners, legislators, and others directly concerned. In other words, I have assumed that the conceptual and methodological problems associated with identifying and measuring relevant educational outcomes can be isolated from the more personal and value-laden problem of deciding what degree of importance should be attached to any particular outcome. The challenge to the researcher, then, is to make sure that his coverage of student outputs is broad enough to meet most of the major concerns of the various constituent groups.

Although it is important that any battery of output measures reflect the interests of as many persons as possible, an adequate assessment of the outcomes of the college experience cannot be limited solely to outputs that are either desired or intended. The unintended outputs or "side effects" of the college experience must be considered, too.

When we talk about side effects in medicine, they are usually regarded as undesirable; but the

side effects of attending college may or may not be desirable, depending on the particular side effect and the value system of the individual immediately concerned. A new college curriculum, for example, may have its intended effects on the student's cognitive abilities, but it may also have unplanned-for effects on, say, the student's vocational and career plans. In short, as long as the possibility exists that a particular output measure is affected by the student's college experiences, that measure should not be rejected as "irrelevant" simply because it does not fit in with some *a priori* educational plan.

A Simple Taxonomy of Output Measures

Because the number of possible output measures is very large, some sort of *taxonomy* of such measures is essential. Taxonomies are useful not only for classifying existing output measures, but also for suggesting additional measures. As a beginning, I would propose that output measures be classified on the basis of three attributes: the type of outcome, the type of data, and the time span involved.

Type of Outcome

Behavioral scientists usually classify measures of human performance into two broad domains: cognitive (sometimes called "intellective") and noncognitive (sometimes called "affective"). Cognitive measures have to do with behavior that requires the use of high-order mental processes such as reasoning and logic. Of all the possible measures of performance that one might devise for evaluating student outputs, those involving cognitive learning and the development of cognitive skills are probably the most relevant to the educational objectives not only of students, but also of faculty, administrators, trustees, parents, and others concerned with higher education.

Noncognitive, or affective, measures have to do with the student's attitudes, values, self-concept, aspirations, and social and interpersonal relationships. Although the number of possible noncognitive outputs is very large, techniques for measuring such outputs are not as far advanced as are those for measuring cognitive outputs.

Type of Data

The second dimension of the taxonomy refers to the operations which are performed in order to obtain measurements of the cognitive or affective outputs under consideration. Again, two broad classes can be identified: *psychological* data relating to the internal states or "traits" of the individual, and *behavioral* data relating to the observable activities of the individual. The measurement of psychological phenomena is usually indirect, in the sense that the investigator *infers* some underlying state within the individual from his responses to a standard set of test questions. Behavioral measures reflecting transactions between the person and his environment are usually of intrinsic interest. Since behavioral (as opposed to psychological) measures typically involve observing the individual in his environment, such measures might also be termed "sociological."

Any student output measure can be classified simultaneously by the type of outcome involved and by the type of data used, as shown in Table 1. Each cell provides examples of different types of outcome measures obtained using different types of data. The cell in the upper left of Figure 1, for example, includes cognitive outcomes that are often measured in terms of the student's grade-point average or his performance on multiple-choice tests of ability and achievement. The undergraduate student's knowledge, basic skills, and critical thinking ability are often assessed by means of batteries such as the Graduate Record Examination (GRE). Achievement in specialized fields can be measured by means of the Advanced Tests on the GRE, and general achievement and intelligence by means of the GRE Area and Aptitude tests. One aspect of cognitive ability for which psychological measures are probably still not adequate is creative ability. Only a few exist (Taylor & Barron, 1963).

The upper right cell of Table 1 includes psychological measures of noncognitive or affective states: the student's ambition, motivation, self-concept, as well as his subjective feelings of satisfaction and well-being. Most of the research on college impact that has been conducted so far has been concerned with psychological measures of affective states. Thus, of the more than 1,000 studies of college impact recently reviewed by Feldman & Newcomb (1969), only a handful used measures of cognitive outcomes and, of these, virtually all used psychological rather than behavioral measures. This bias is, to some extent, probably a matter of logistical convenience. Psychological measures of affective states — attitudes, values, career plans, and the like — are simple and inexpensive to administer to undergraduates before, during, and after they attend college, whereas measures of cognitive outputs and measures of behavioral or sociological outputs ordinarily require considerable time and expense to administer.

TABLE 1. A TAXONOMY OF STUDENT OUTPUT MEASURES IN TERMS OF TYPE OF OUTCOME AND TYPE OF DATA

Type of Data	Cognitive	Affective
Psychological	Knowledge General Intelligence Critical Thinking Ability Basic Skills Special Aptitudes Academic Achievement	Self-concept Interests Values Attitudes Beliefs Drive for Achievement Satisfaction with College
Behavioral	Level of Educational Attainment Vocational Achievements: level of responsibility income awards of special recognition	Choice of a Major or Career Avocations Mental Health Citizenship Interpersonal Relations

The lower left cell in Table 1 gives examples of behavioral or sociological measures of cognitive outputs. Basically, this category refers to outputs which reflect the behavior of the student (or former student) in society and which ordinarily require cognitive skills. Presumably, these real-life achievements represent the behavioral manifestations of the cognitive traits listed in the cell above.

The fourth cell, located in the lower right quadrant of Table 1, includes sociological or behavioral features of the individual's development that reflect primarily affective states. Under "avocations," for example, one might include the amount of time spent by the person in various recreational pursuits. "Citizenship" might be manifested in the amount and quality of participation in community activities, the earning of special awards for service to the community, or, on the negative side, welfare or arrest records.

It should be pointed out that the two dimensions comprising Table 1 are really more continua than true dichotomies. For example, a person's earned income and job status (which would be subsumed under "vocational achievements" in the cognitive domain) may involve his noncognitive or personality traits.

With respect to the two types of data (psychological and behavioral) defining the two rows of Table 1, it is important to keep in mind that psychological measures are less likely to be regarded as socially relevant outputs than are the behavioral measures. Nevertheless, some psychological measures "acquire" behavioral significance as the result of empirical research. Measures of general intelligence and academic ability, for example, have acquired behavioral significance because longitudinal research has shown that persons with high scores on such measures are usually successful vocationally and socially (Terman & Oden, 1947; Nichols & Astin, 1966). The connection between psychological and behavioral measures in the affective domain, however, is much less well-established. Perhaps the only instance in which psychological measures of affective outputs are known to bear more than a trivial relationship to subsequent behavioral phenomena is interest measurement. Measured vocational interests are closely associated with later career development and success over many years (Strong, 1955).

Time Span Covered by the Measure

The four cells shown in Table 1 could be extended into a third dimension to portray the temporal aspects of the output measurement being used. Although it is not often considered in dis-

cussions of educational outputs, time is a fundamental consideration. Is it more appropriate to measure the immediate outputs of the college experience — that is, those that take place after only a brief span of time — or the outputs which show the long-term effects of the college experience?

Most educational institutions are designed with the hope of producing long-term rather than short-term changes. The goals stated in college catalogs, for example, imply that the institution is primarily concerned with making an impact on the student that will last throughout his lifetime. The college, it would seem, tries to provide experiences which will assist the student in making the fullest possible use of his talents and in becoming an effective, responsible member of society. Presumably, such effects will, in turn, result in a more satisfying and rewarding life.

For many prospective college students, however, such long-term effects are too remote and too difficult to comprehend. These students are primarily interested in much more immediate goals — their actual experiences during the undergraduate college years — rather than in how these experiences will affect their later development. Educators frequently overlook the fact that the two, four, or eight years of college represent a sizable proportion of the student's total life span. To him, then, college experiences are important in and of themselves, not merely in what they will mean later on after the student leaves college.

It seems likely that psychological measures, particularly of cognitive outputs, are most relevant for the college years, whereas behavioral measures are more suitable for assessing both short- and long-term effects. The point to keep in mind is that the appropriateness of any output measure — whether it be cognitive or affective, whether it be derived from psychological or from behavioral data — is determined in part by the period of time spanned by the measure. Clearly, there are valid arguments for using both short-term and long-term measures.

The importance of timing in the development of output measures can be illustrated with a hypothetical example. Let us assume that a student from a small rural high school enrolls in a highly selective and academically competitive institution. His initial experiences result in a variety of relatively short-term or immediate outputs, both psychological and behavioral, both cognitive and affective. Affectively, the student feels anxious about possible academic failure, hostile and competitive toward fellow students, and proud of the institution. On the behavioral side, he devotes more time to study and less to social activities, and he becomes more intellectually aggressive toward his fellow students and his instructors, more inclined to argue with them. Such affective changes might be assessed by means of inventories or questionnaires administered at the time of matriculation and again after a few months in college. On the cognitive side, our hypothetical student becomes much more knowledgeable about certain subjects as a result of his increased devotion to study. Such knowledge would, presumably, be reflected in followup achievement testing. Behavioral manifestations of cognitive changes take the form of his being elected to honorary societies and receiving awards for special achievements (essays, authorship of publications, etc.).

The longer-range effects of attending the highly competitive institution can also be classified by type of outcome and by type of data used. To return to our hypothetical student, we find that in the affective domain his four years in the highly competitive institution have fairly long-lasting effects on his self-esteem, as well as on his feelings of competitiveness, anxiety, and inferiority. These psychological changes are also manifested behaviorally in the amount of time he devotes to his job and by the extent to which he competes with others on the job. Cognitive outcomes of attending the highly selective college are reflected in his successfully completing graduate school and, later, in his achieving a high-level position, a high salary, and special awards from his professional society for outstanding achievement.

It should be pointed out here that psychological measures of cognitive outputs, such as performance on standardized tests, are usually not obtained once a person leaves formal higher education. In fact, the person who holds a college degree normally does not have to take cognitive tests that are otherwise required by the military, industry, and the civil service. But there is no reason why cognitive testing could not be used at *any* time following college, given adequate resources and the subject's willingness to participate.

Relative Versus Absolute Measures

Our discussion of Figure 1 has already suggested that the problem of defining educational outcomes is inextricably bound up with the methodology employed to secure the actual measure. Methodology involves not only the operations that are performed to gather the raw data but also the manipulations of the raw data by which the final "measure" is derived. In the field of achievement testing, for example, the common practice is to

devise a list of multiple-choice test items; administer them to a sample of students; count the number of items answered correctly by each student; and then calculate a *derived* measure which is expressed in terms of a standard score, a percentile score, or some other relative value. That is, a person's final score reflects only how he has performed relative to others.

In achievement and aptitude testing, relative measures are used almost universally as measures of educational outcomes. But they present some potentially serious problems. Such measures indicate nothing about the student's *absolute* level of performance. They give no direct information as to how many items the student answered correctly, how difficult the items were, or what the student's test performance implies about his potential for performing well on the job, profiting from further education, and the like. More important, such relative measures offer no way of reflecting *changes* in the student's performance over a period of time. Thus, it is possible for a student's absolute (i.e., actual) performance or competence to improve considerably over a period of time, while his relative performance remains the same, or even declines during the same period.

There are several explanations as to why specialists in educational measurement have a predilection for relative rather than absolute measures of performance. One argument for derived scores (particularly standard scores) is that they possess certain statistical properties that make them more suitable for some types of analyses. A more subtle explanation involves the meritocratic bias of the culture and, in particular, of the educational system. Derived scores, which are an indication of the person's relative ordering among his peers, provide a convenient means of identifying the most talented persons for purposes of recruitment into jobs, graduate and professional schools, and other areas where competition for a finite pool of talent is strong. Nevertheless, *for purposes of assessing the impact of any college on the student's development, derived or relative measures of student outputs appear to have very limited usefulness.*

There are several possible approaches to the problem of developing measures of absolute performance. If the measure is based on the types of multiple-choice items usually found in aptitude or achievement tests, perhaps the most straightforward approach is simply to record the number of items correctly answered. Change or growth in the student's development can thus be measured in terms of increases in the number or percentage of such items correctly answered. One useful elaboration of this approach is to develop expectancy tables that show the probability of various events (performing well on the job, for example) as a function of the number of items correctly answered. Change or growth can then be measured in terms of increases in these probabilities over time.

Another approach to the development of absolute measures of performance is to label particular points on the distribution of scores (whether they be raw or derived) in terms of the level of performance typical of that point. For example, if one were interested in using an output measure of general intellectual achievement, the lowest scores would indicate borderline literacy, and the highest scores would correspond to the level of intellectual achievement normally required of students pursuing Ph.D.-level graduate education. The significance of particular scale points would be made even clearer, if examples of actual items were used to show the most difficult types of items passed by the majority of people scoring at a particular point on the scale.

Absolute measures of performance probably provide the ideal basis for making educational objectives explicit. Let us assume, for example, that we have constructed a measure of cognitive performance that covers a wide range. This measure is represented by the distribution shown in Figure 2-a (we have made the distribution "normal" in shape, but there is no necessary reason why the actual distribution of raw scores in the population could not assume some other shape). Two major cutting points on the score distribution have been identified: "borderline literacy," at the low end of the continuum, and "Ph.D.-level performance," at the high end. Let us assume that the normal distribution shown in Figure 2-a represents the scores of the total population of potential college-going students at the point of graduation from high school. Note that only a very small fraction of the population is performing at the Ph.D.-level at the time of entrance to college, but that a substantial proportion is performing at or below borderline literacy (the cross-hatched areas of the distribution above and below these two points are arbitrary; they have been drawn as shown simply for illustrative purposes). The desired educational output — the goals of the higher educational system, if you will — can be specified in terms of *changes in the characteristics of the distribution.*

Although an almost infinite number of such changes might be desired, Figures 2-b, 2-c, and 2-d are examples of only three basic types of changes. The solid lines in each of these three figures show the desired shape of the distribution

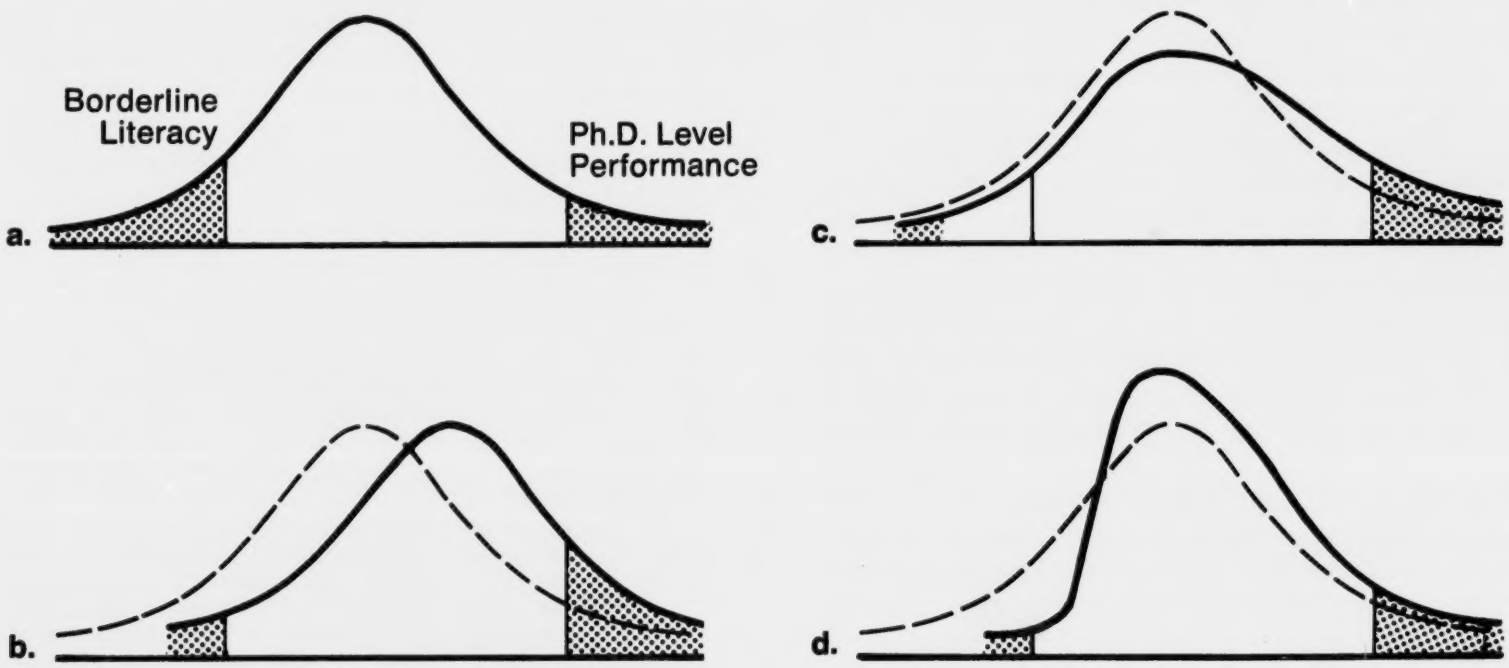
after four years of college (the student output); the dotted line which is superimposed on each figure shows the distribution at the point of matriculation (the student input). The first of these hypothetical changes in the performance distribution (Figure 2-b) involves an upward shift in the students' *mean* performance, only. Note that the entire distribution has simply shifted to the right and that the shape or dispersion of people remains unchanged. One might refer to this as a sort of "democratic" or "egalitarian" plan.

An alternative educational outcome is portrayed in Figure 2-c. Here the proportion of the students performing at or near the Ph.D.-level has been substantially increased, while the scores of those at the lowest parts of the distribution remain almost unchanged. This type of change, which is concerned primarily with increasing the proportion of very high-performing students, might be characterized as an "elitist" plan, in the sense that emphasis is placed on increasing the number of very high performers; and there is relatively little concern with improving performance at the lowest end of the continuum. This type of cognitive objective has characterized much of American higher education in the past.

A third alternative outcome, shown in Figure 2-d, is concerned primarily with minimizing the proportion of low performers. Here the number of persons performing at or near borderline literacy is greatly reduced, but the number of performers at the high end of the distribution changes only slightly. Since it is concerned primarily with the eradication of illiteracy, this approach might be labeled as "remedial."

Many other changes in the distribution of scores are, of course, possible. My intention here is to emphasize that the specification of any educational output requires more than just the development of a measure such as "cognitive performance"; it requires as well the specification of what changes are desired in the distribution of the target population. Note that the desired change as specified in figure 2-b involves an alteration only in the students' *average* performance, whereas the changes shown in the last two distributions involve alterations in the *variation* of scores as well. The "elitist" approach results in an increase in score variation by stretching out the scores at the high end of the distribution; the "remedial" approach, on the other hand, results in a decrease in the dispersion of the scores because of major increments to the scores of the lowest-performing individuals.

FIGURE 2: HYPOTHETICAL DISTRIBUTION OF INTELLECTUAL ABILITY IN THE POPULATION OF ENTERING COLLEGE STUDENTS (A), AND THREE POSSIBLE OUTPUTS OF THE HIGHER EDUCATIONAL SYSTEM EXPRESSED IN TERMS OF CHANGES IN THE SHAPE OF THE DISTRIBUTION (B, C, & D).



Determining whether or not the desired changes in performance have taken place involves additional problems in measurement. It is not enough just to ascertain if the mean performance of all individuals has improved, or even if the variation (the standard deviation) has increased or decreased. (An increase in dispersion or standard deviation could result from a deterioration in the performance of the lowest-scoring individuals as well as from substantial gains in the scores of highest-performing individuals.) One method is to develop several dichotomous measures based on critical cutoff points in the distribution ("borderline literacy" and "Ph.D.-level performance" represent just two such cutoff points). It might also be useful to study changes in the shape of the distribution as reflected in measures of skewness and kurtosis.

The input-environment-output model of student development in higher education (Figure 1) is designed primarily to aid the investigator in assessing the impact of different types of environments on relevant student outputs. Student input data are needed in order to measure changes in the student's development and to make statistical adjustments for the non-random distribution of students among institutions; environmental data are needed in order to identify those institutional attributes which affect the student outputs under investigation. Longitudinal studies involving these three types of data can yield information on the causal connections between environmental and student output variables. Such research information can, in turn, provide the basis for developing models of the higher educational system which can be used in planning.

Aside from the methodological problems involved in studying environmental effects on students, several considerations must be taken into account in designing or modifying environmental variables in order to produce changes in the distribution on some student output measure. First, the *target population* must be defined. Does the distribution shown in Figure 2-a, for example, refer only to the college-going population, or does it include as well high school graduates who do not go on to college? Even if the target population is defined to include only those who will actually go to college, the investigator must be prepared to deal with temporal changes in the characteristics of this population. The number of available scholarships and loans may increase; recruitment activities may be intensified; and other changes may occur which affect students' decisions to go to college. In view of these possibilities, defining the population to include all *potential* college students* has the advantage of permitting the investigator to include recruitment practices and admissions policies among his array of environmental variables and thereby to estimate how various changes in these policies and practices would affect the distribution of the total population on the output measure.

Second, one must be aware that certain changes in a person's output performance may be *developmental* or *maturational* in nature. That is, no matter what sort of college experience a person has, and even if he never attends college, his cognitive abilities and other output performances will undergo change with time. Thus, if Figure 2-a shows the output distribution in the population at one point in time, the distribution will probably be different at some subsequent point in time, even if none of the population attends college. For example, it seems likely that many persons at the low end of the distribution will show a substantial *decline* in cognitive performance after high school if they receive no further formal education. Clearly, one needs estimates of these expected changes in output among non-college students in order to assess the potential impact of changes in recruitment or admissions policies.

Perhaps the biggest problem in using student output measures for educational modeling is posed by the existence of multiple output measures. The statistical problems in dealing simultaneously with several output measures greatly complicate the investigator's analytic task.** In addition, because persons differ so greatly in the importance that they attach to different outputs, what may be seen as an educational "side effect" by one person may represent the principal educational objective of another. Under these circumstances, the investigator's model must be able to accommodate several output measures simultaneously, so that any decision to manipulate environmental variables in order to produce changes in certain output variables can be made with a knowledge of how other output variables are likely to be affected.

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* The population of "potential" students would include all those who could be persuaded to attend college under conditions of maximum incentive. Defining what constitutes "maximum incentive," given finite resources, is, of course, an important unsolved problem that merits a major research effort.

** Because they weight dependent (output) variables basically in terms of their *predictability* rather than their actual importance, statistical techniques such as canonical correlation and multiple discriminant analysis are probably inappropriate for dealing with multiple output measures; separate analyses for each output measure are probably more appropriate under these circumstances.

Conclusions

In this paper, I have attempted to deal with several problems related to developing measures of student outputs in higher education. The following are among my major points:

1. Student outputs can be understood if they are viewed in relation to the total higher educational system. Specifically, student outputs should be considered as part of a three-component model comprising student outputs, student inputs, and characteristics of the college environment. Educational planning requires a knowledge of how outputs are affected by environmental variables. Such effects, however, cannot be determined without information on student inputs.

2. Because of great variations in the values and objectives of different persons, any attempt to develop a single "overall" student output measure is unrealistic. Rather, the investigator must seek to develop a battery of measures that is sufficiently broad to satisfy the major concerns of a substantial number of students, educators, and planners. In addition, provision should be made to include measures of possible "side effects."

3. A preliminary taxonomy of student-output measures would include the following three dimensions: the type of outcome (cognitive versus affective), the type of data (psychological versus sociological), and the temporal aspects of the measure (short-term versus long-term). This taxonomic scheme should prove useful, both for classifying existing measures and for identifying gaps where additional measures are needed.

4. Although relative or derived measures are widely used in educational research, particularly in the measurement of cognitive outputs, such measures present serious conceptual problems which limit their value for modeling and planning. Whenever possible, the investigator should strive to develop absolute rather than relative measures of student outputs.

5. The use of output measures — whether relative or absolute — in educational modeling and planning requires that the desired population changes, in the distribution of scores on each measure, be specified. In planning such changes, the investigator must consider changes in the *shape* of the performance distribution as well as changes in the mean and variance.

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"The legislator, university administrator, or educational reformer wants to know... what will happen if a conscious, concerted effort is made to try to get more of a particular output."

"When my son Christopher got all A's in first grade but found school repressive and dull, the argument that his grades indicated a successful and lucrative future was little consolation to him or to me."

"Most of the cost of higher education is the wages foregone while in college."

"It is beginning to appear that the most overrated argument for public subsidies of higher education is that made on the grounds that there are externalities or spillovers from an individual student's education which benefit us all."

"Many higher education activities are billed as benefiting 'the public,' when, in fact, they merely represent the effective lobbying of special interests, including university faculty."

Public Service Outputs of Higher Education: An Exploratory Essay

JOHN E. BRANDL*

This paper is devoted to beginning a discussion of the public service outputs of higher education. These are defined as non-research benefits (or costs) accruing to persons other than students and employees of institutions of higher learning.[1] For some such activities an institution is reimbursed directly, for others, not; so the discussion is not limited to the latter cases, despite the fact that public service seems in common usage to carry connotations of generosity or altruism. There is virtually no literature on this question — which helps to explain both the timid goals and the modest achievements of the paper. Anecdotes on the civic-mindedness of the college educated,[2] and rhapsodies on the contributions to American agriculture of Land Grant Colleges[3] nearly exhaust what has been said.

The reason why we are worrying about the outputs of education in this symposium is that education is a government-dominated field in which governmental involvement has traditionally been justified on the grounds that in three important ways the market breaks down. The three are: (1) externalities of education, *i.e., societal* benefits flow from an *individual's* schooling; (2) the public good nature of the product of research, *i.e.,* ideas are available to the entire society which therefore can be called upon to finance their production; and (3) the neutrality of the market on the question of egalitarianism, *i.e.,* education is often seen as a mechanism fostering equality of opportunity and thus redistribution of income. But other institutions in the society also exist to remedy one or more of these ills. When a university takes on burdens outside its mandate, it weakens its ability to perform some of its classic functions — which may not be bad, but which does point up the central problem of this symposium. Higher education is many things to many people; it is impossible to compile a self-consistent, yet complete, list of the goals of a university.

The paper is organized as follows. Section I discusses recent technical developments in higher education administration. Section II, the heart of the paper, argues that for some of their activities faculty members and students should be considered as acting independently, not as producing "outputs" for their university. Furthermore, it is claimed that the analytical techniques for estimating production functions of firms are inapplicable to universities. After that, Section III outlines what is left of the public service outputs of higher education. Section IV looks at these outputs through the eyes of the four groups of constituents suggested by the organizers of this symposium.

* The author is grateful for the advice of James Jernberg, Eugene Eidenberg, Robert Holt, and the participants in the Conference on Public Service Outputs of Higher Education.

I. Recent developments, education finance and management

In the last decade the field of higher education administration or management has been influenced by three important developments:[4] (1) the extension of general public finance analysis to the costs and benefits of higher education; (2) the flourishing of the point of view that education can be considered as developing human capital, as an investment in making people more productive resources; and (3) PPBS (planning-programming-budgeting systems) and all of the works and pomps associated with this management device.

The contribution of the economics of public finance to higher education administration has been to emphasize what is clear to most people — that the unfettered market cannot be expected to allocate education properly. Capital market imperfections make it difficult, if not impossible, for an individual with no collateral but himself to borrow money on his future. Education of a student supposedly carries benefits for others in the society as well, but these externalities tend to be ignored by the individual purchaser of education. Finally, and most importantly, the market can in certain circumstances allocate goods and services *efficiently,* but it is blind to questions of *fairness;* as a society we may wish to subsidize some of our members otherwise without the wherewithal to finance their desires for higher education. Historically, America counteracted these deficiencies of the market by providing universal free elementary and secondary education and mammoth subsidies to higher education.

The infusion into this situation of public finance analysis and the economist's penchant for charging the beneficiary of a good for the good have led recently to increased use of the market. Where subsidies are desired this has meant moves

away from governmental support of the *institutions* of higher education and toward support of students deemed worthy of assistance by reason of their unusual skills or financial deprivation.[5]

In the 1960s came apparent statistical justification for these subsidies; education viewed as the forging of a productive resource (people) seemed, overall, to be a worthwhile investment.[6] But *overall* estimates of the productive value of education for the nation do not indicate whether *incremental* expenditures on education are well spent, nor do they uncover the relative effects of the various components of the educational process (teachers' brains and training, school buildings themselves, textbooks, native ability of the student, parental influence).

However, attempts to go the next step, to estimate production functions for education — to define and measure critical inputs and outputs of the educational process — have been unsophisticated in technique and disappointing in results.[7]

The disappointment is keenest where evaluations have not shown startling achievement increases for students in compensatory education programs.[8] Hope that America's social ills could be overcome through educational efforts, such as Title I of the Elementary and Secondary Education Act of 1965 or the Head Start Programs of the Office of Economic Opportunity, must now rest on the conviction that our evaluative instruments are faulty or that the best in current practice is not now present in these compensatory programs, but could be introduced.

Very recently there has been some indication that earlier assessments of the role of education in economic growth were exaggerated. Fast growing industries no longer seem to have a relatively greater need for highly educated personnel: "Currently, we have very little evidence that the present level of technological change needs to be supported by even higher levels of education."[9]

Significantly, these and other signs of weakness in the human capital argument for income redistribution through education, have led recently to questioning and even renunciation of the education-as-investment approach and a corresponding championing of education as consumption. Some lawyers and constitutional scholars are now arguing that test scores are irrelevant in making a case for improved education for the deprived.[10] If suburban students can luxuriate in small carpeted classrooms equipped with dazzling educational paraphernalia, how can one argue that their disadvantaged contemporaries do not deserve the same, regardless of whether they affect educational outcome? And surely, demands for open enrollment in higher education grow, at least in part, from the perception that college is where it's at, never mind what happens in the future.[11]

So, despite some fanfare in the economics profession, the human capital formulation has so far had little direct influence on public policy.

Simultaneously, with the public finance and human capital developments, a new management tool, PPBS, has begun to be implemented in some institutions of higher learning. Ideally, a PPB system should involve an information system organized to keep track of outputs rather than inputs, good analysis, and organizational arrangements which insure that policy is translated into action: That individuals acting in their own interest are furthering society's interests. So far the great bulk of the work that has gone into developing PPB systems has been in the first of these; that is, into sterile accounting schemes and computer crosswalks. Good analysis and organizational reform happen much less frequently.

These developments — PPBS plus the economics of public finance and of human capital — have brought about the current output orientation in higher education administration. But the quest for the outputs of education is severely crippled by serious and imperfectly perceived (by many questers) methodological and technical difficulties. The next section outlines these difficulties.

II. The University As Non-Organization

There are irreconcilable differences in this society as to what the outputs of higher education are. PPBS does not provide a *theory* for deciding what they are and how to measure them. Presumably economic analysis can provide the theoretical skeleton and mathematical statistics the empirical flesh to this elusive animal — educational output. But economic theory has to do with maximization (consciously or unconsciously) of known objectives. Where an objective or output is known (or felt) and an organizational entity is motivated to maximize it, economics provides a descriptive theory of how maximization will happen or prescriptive analysis as to how to get it to happen. That is, with existing analytical tools, economists can classify, measure, and maximize outputs when they are identified, and the incentive to maximize exists. But economics is not of much help in *determining* objectives or outputs and is misleading in situations where objectives are not maximized, which is clearly the case in higher education where there are numerous competing viewpoints of what is going on.

A university is not a person or a firm; it is not the single-minded entity presumed in the use of management tools which have brought about this output orientation. No budget or plan of a college is compatible with a single, self-consistent set of preferences.

What to Measure

The notion of an output has implicit in it that an entity or mechanism is seeking to produce an output, indeed maximize it. Where there are conflicting views or theories of what "is" and of what "should be," there can be no agreement on what are relevant outputs. For it is a viewpoint or theory of the educational process which tells one what outputs are, what should be measured. "Measurement without theory . . . "[12] is a delusion. Different views, *different theories,* of the educational process — that it produces humane citizens or productive cogs; preserves the wisdom of the past; guarantees a technologically advanced society; furnishes a safe and fruitful base from which to effect societal reform or revolution; provides an enjoyable interlude between childhood and work-a-day-ism — these different views suggest different outputs, and who is to say that one view is "right"? Compiling long lists of "outputs" is of little usefulness in the absence of behavioral theory relating inputs to the outputs.

How to Measure

The obvious response to the foregoing paragraph is that one can always list all the outputs suggested by all the competing theories and then proceed to measure the degree of attainment of each. Here, the standard procedure is regression analysis relating an output on the left side of the equation to a host of inputs on the right, the coefficients of the input variable presumably indicating their relative importance. But even that will not do.[13] It will do as a collage, an encyclopedic description which might be distributed as an appendix to the college catalog. But it will not do as a guide to public policy. For what the legislator, university administrator, or educational reformer wants to know is what will happen if a conscious, concerted attempt is made to try to get more of a particular output. Measuring what has been happening in a university where many outputs are being produced and no one or no cluster is being maximized will not yield information on efficient allocation *or even on what would happen if an attempt were made to get more of a particular output.*

The production function - regression analysis approach of the cost-benefit analyst is borrowed from the economics of the firm, where the profit-maximization axiom provides a rationale for claiming that the regression equation yields a locus of *efficient* combinations of inputs. Where there are *joint outputs* in a *non-maximizing* environment, there can be no presumption that input-output calculations yield either efficient patterns or patterns that are even replicable in a different time or school, where different preferences may prevail.

Lacking powerful behavioral theory on the actions of academic bureaucrats and political theory to predict the outcome of clashes of competing claims, we are in no position now to measure all the outputs of a university. Existing political analysis on resolving conflict is of little value in this instance. Prevailing political theory, consciously or unconsciously patterned after the invisible hand notion of economics, has aspired to be both descriptive and prescriptive — ratifying outcomes of the political process on the grounds that competing claims are, in fact, settled in the political "market place." But dissatisfaction is very great with this characterization of political processes (in government or universities).[14]

Not only are there conflicting views on goals, but *running* a university may be a contradiction in terms. At any rate, it is a far cry from running a firm. "The main pattern of academic organization is associational rather than bureaucratic. It does not stress 'line' authority, since basically all full faculty members are formal equals . . . . Indeed, relative freedom from the authority of organizational 'superiors' is one of the main aspects of academic freedom."[15] Academic organization is, then, the institutionalized antithesis of the firm or government bureau, where superiors control the actions of subordinates. The fact that a university is not a unit is what allows diversity in teaching and research.[16]

No wonder then, that there has been little progress in measuring the outputs of universities. Existing techniques were designed for organizations with an incentive to produce efficiently an agreed-on product. In contrast, a university is in many ways, a non-organization, where there is no agreement on its product, the independence of the individual faculty member is valued highly, and there is surely no inherent goad to maximize. Indeed, a mechanism for maximizing some combination of outputs may be inconsistent with the idea of a university. A university is designed not for *reconciling* conflicts, but for *permitting* them.[17]

For many purposes, the activities of individual faculty members should not be linked to the university. This concept narrows the range of the university's involvement in public service.

III. Public Service Outputs

Four output categories were suggested for this symposium: undergraduate education, graduate education, research, and social involvement. In order to distinguish from the outputs in the first three categories, outputs of public service or outputs of social involvement activities of an institution of higher education are defined here as non-research benefits accruing to persons other than students and employees. As might be inferred from the two previous sections, ideological convictions as to the nature of a university, combined with practical assessment that an institution of higher learning is ill-suited to carry out many social missions, lead me to a narrow definition of what should properly be considered public service outputs.[17]

The guiding notion in what follows, then, is that public service activities of faculty members are not the concern of the administration of a university. Faculty members should be free to dabble in the design and operation of programs combatting the problems of crime, pollution, race, and poverty and be paid to do so by anyone willing to believe that professors are good doers. Correspondingly, universities needn't measure the "outputs" thus generated, nor pay faculty members for time thus spent. There remain some public service activities of the university, *per se*, and these will be discussed shortly.

In every case they grow out of the teaching or research missions of the university. They come about, jointly produced with teaching or research, as external benefits (or losses!) spilling over to nonstudents from the educational process.

Public service outputs seem to be of three kinds:

1. Direct services to individuals

Direct services to individuals can be divided between those for which the university is reimbursed and those for which it is not. The distinction is crucial since, in the former case, measurement of benefits is made unnecessary (or at least much easier to accomplish) by market valuation. Interestingly, one such activity, often listed as a public service, is university extension. This is inappropriate when extension is simply courses offered to students in the evening or by mail. Extension is typically self-supporting,[18] all the more reason for listing it as undergraduate or graduate education, not under the public service rubric with attendant connotations of largesse on the part of the university.

Another type of "public service," which like extension does not belong in this category, is government-subsidized training for particular professions. Thus, universities abound with federally financed programs designed to produce specialists in tranportation, urban planning, systems analysis, etc. These should be priced at cost and listed as undergraduate or graduate education. Presumably the student, not society, is the recipient of the benefits of such a program, for, if when he leaves the university he is better at what he was trained for than when he came, he will be paid more. (If a buyer — say his former employer — is not willing to pay him more, someone else will.)[19]

But there is a class of direct services to nonstudents which can properly be considered public service. These are activities which flow necessarily from teaching and research. Hospitals and dairy stores are examples. The problem here is not output measurement, but price determination, the difficulty being that the service is produced jointly along with teaching and research, and it is impossible to attribute costs to the three.[20]

The difficult problems under this first category arise when the university is not reimbursed for a service. The most important example is the filtering or credentialing process which universities perform for employers. Students with the stamina to make it through college obviously are identified as of some value apart from what they know. This function is akin to that of discovering talent, which Theodore Schultz has elevated to the position of one of three major functions of higher education, along with instruction and research.[21] The value of this service is, at least, potentially measurable. One might begin, for example, by noting the difference between what employers are willing to pay two individuals, one with and one without college education, whose performances on standardized achievement and aptitude tests are identical. Though sorting or "discovering talent" may be valued highly by some, it is not universally regarded as a good. Town-gown physical confrontations and demands for ungraded classes are indications that not everyone appreciates being pigeon-holed by the academic process.

A final item in this category of non-reimbursed services is public goods, for example, radio and television broadcasting.[22] Again, these are often jointly produced with instruction, and it is difficult to measure their benefits. In the absence of scrambling devices on owners' sets or some other exclusionary mechanism measuring the value of this service is subject to all the difficulties of pricing any public good, where a recipient has an in-

centive to understate (to the producer of the service) the value he places on it.[23]

2. Income Transfers

Traditionally, higher education in this country has been regarded as an equalizer of opportunity. No doubt many Americans feel that the Horatio Alger myth justifies the fact that very few institutions of higher learning charge students full instructional costs. Philanthropies and governments subsidize education, not only in recognition that research costs should not properly be borne by students, not only because of external benefits to society, not only because the money market for student loans is inefficient, but also because of a belief that low tuition subsidizes the economically disadvantaged. This clearly is an empirical question, one on which little work had been done until very recently. Recent findings by W. Lee Hansen and Burton A. Weisbrod on the distribution of education subsidies in higher education in California are shocking.[24] Far from establishing the generosity of the well-heeled, it appears that, on balance, educational subsidies rise for successively higher income groups. (The university system is costlier than the state colleges which are costlier than the junior colleges which are costlier than not educating a person at all. But the average income of Berkeleyites is greater than the average income of San Francisco State students, etc.) Hansen and Weisbrod discovered that the situation in Wisconsin is less discomforting, emphasizing the great need to perform the relatively straightforward task of measuring educational subsidies by income group. This task should be extended to include the measurement of subsidies by ability level as well. For unless there are great externalities associated with educating the most capable students (which I doubt), then the widespread practice of awarding scholarships to bright students may be but another bit of income redistribution from the less well off to the better off in the society. This is not only because such students *come* disproportionately from higher income groups, but also because being both talented and educated, they will tend to be highly paid *in the future*.

Note that dropping tuition rates to zero for all is hardly a solution, since *most of the cost of higher education is the wages foregone while in college*.[25] It is certainly plausible that at zero tuition, these costs are more prohibitive to the poor student than to the rich one.[26]

3. External or spillover benefits from students to others in the Society

In 1966 Theodore Schultz had called for someone to measure the income redistribution effects of higher education; that work is under way.[27] Now the great need is to measure externalities. It is beginning to appear that the most overrated argument for public subsidies of higher education is that made on the grounds that there are externalities or spillovers from an individual student's education which benefit us all. The only serious study of this question is Burton Weisbrod's 1963 monograph, *Spillover of Public Education Costs and Benefits*.[28] But this was concerned primarily with pre-college education and by 1969 Weisbrod (with W. Lee Hansen) was saying, "Our apparent skepticism about either the existence or significance of some of the widely discussed external benefits from higher education stems principally from the absence of any substantial body of evidence in support of them."[29] Here, then, the problem is not one of devising operational measures of outputs, but in finding empirical evidence that they exist. Indeed, when they do, they may be negative.[30] Categories for consideration of externalities have been worked out by Burton Weisbrod[31] and can be accepted here. (See table.)

PUBLIC SERVICE OUTPUTS

Direct Services to Individuals

- Reimbursed
- Non-reimbursed

Income Transfers

- To economically disadvantaged
- To academically adept

External Benefits to Non-students

- Residence-related
- Employment-related
- Society in general

IV. Constituencies and Their Perspectives

This section sorts out the above services, transfers, and benefits in terms of the categories defined by the organizers of this conference. Four constituencies were proposed: the public, private interests, faculty, and students.

The Public

Higher education's services to the public are:

1. Redistributor of income (scholarships)
2. Provider of public goods (broadcasting of faculty lectures)
3. Furnisher of benefits which spill-over from the instruction process (I do not know what these are.)
4. Market for services (Training for professions deemed worthy of subsidies.)

The need to price at cost and/or to keep track of who is getting what, is great. Many higher education activities are billed as benefiting "the public," when, in fact, they merely represent the effective lobbying of special interests, including university faculty.[32]

The Private Sector

The last sentence is, of course, relevant here. For the private sector the university is:

1. Provider of training services (often not a "public service")
2. Seller of services produced jointly with instruction or research
3. Seller of "monuments"[33]
4. Sifter of talent

The last function is the most difficult to handle, since it is difficult to set a price for it.

Faculty

From the standpoint of public service, this paper's main argument concerning faculty is that they ought to deal as independent agents, not as part of a university organization.

Students

To students the university's public services are:

1. Provider of income transfers
2. Provider of services

Some students are recipients of income transfers from the rest of society. In the absence of evidence of external benefits from education to the public, it is difficult to make a case for such a transfer to all students. Students as members of the public ought, of course, to be eligible recipients of such direct services as the university provides, as, for example, health care.

V. Conclusion

Much accommodation of special interests has masqueraded as public service. Faculty members doing public service, which is independent from teaching and research, should do so as independent agents. University services should be priced at marginal costs in the interests of both efficiency and equity. Economic analysis, which has fostered the output orientation in higher education, is not appropriate for finding or measuring educational outputs. Universities are neither the firms of neoclassical economics, nor the bureaucracies of the Weberian tradition in sociology. Not only are the measurement techniques inappropriate, but precisely in those areas (public service) where they are inappropriate, they are unnecessary, since the university *qua* university is not producing those outputs — individuals.

NOTES

1. The terms "university," "college," and "institution of higher learning" are used interchangeably in this paper.

2. V. O. Key, *Public Opinion and American Democracy* (New York: Alfred A. Knopf, 1961), p. 324.

3. E. D. Eddy, Jr., *Colleges for Our Land and Time: The Land-Grant Idea in American Education* (New York: Harper and Brothers, 1957).

4. *Technical* developments, that is. Clearly, the main difference between educational administration now and a decade ago is that students now insist on a larger role in university government.

5. This was recommended by the following two influential reports, one done inside, the other outside the government: "Toward a Long-Range Plan for Federal Financial Support for Higher Education: A Report to the President," U.S. Department of Health, Education, and Welfare, January 1969; and "Quality and Equality: New Levels of Federal Responsibility for Higher Education," Carnegie Commission on Higher Education, December 1968. On March 19, 1970, President Nixon announced a plan to reorient federal subsidies to higher education toward assistance to students, particularly the financially disadvantaged. *New York Times,* March 20, 1970, p. 1.

6. Theodore Schultz and Gary Becker (among others) developed the theory for considering education as developing "human capital." Meanwhile Edward Denison made empirical estimates of the part of economic growth in the United States that could be attributed to education. He attributed 40 per cent of growth in the national income per capita from 1929 to 1957 to increases in time spent in school. See Schultz, *The Economic Value of Education* (New York: Columbia University Press, 1963); Becker, *Human Capital* (New York: National Bureau of Economic Research, 1964); Edward Denison, *The Sources of Economic Growth in the United States* (New York: Committee for Economic Development, 1962).

7. Samuel Bowles has written an elegant critique of education production function estimation methodology in "Toward an Education Production Function," to be published in the proceedings of a National Bureau of Economic Research Conference on Research in Income and Wealth, held in Madison, Wisconsin, November 15-16, 1968.

8. Many recent evaluations have shown slight if any increases in students' cognitive skills after exposure to compensatory education. See, for example, the following studies of Title I ESEA and Head Start, respectively: E. J. Mosbaek and others, "Analyses of Compensatory Education in Five School Districts," TEMPO, General Electric Company, Washington, D.C., August 16, 1968; and *The Impact of Head Start,* Westinghouse Learning Corporation — Ohio University, June 12, 1969. Evidence of success with older children and with college students is even harder to find.

9. Joseph Froomkin, *Aspirations, Enrollments and Resources: The Challenge to Higher Education in the Seventies* (Washington, D.C.: Office of Education, Office of Program Planning and Evaluation Planning Paper 69-1, May 1969). This manuscript is a gold mine. See also D. W. Jorgenson and Z. Griliches, "The Explanation of Productivity Change," *The Review of Economic Studies*, July 1967; and E. J. Denison, *Why Growth Rates Differ: Postwar Experience in Nine Western Countries*, (Washington, D.C.: The Brookings Institution, 1967). Estimates of the contribution of education dropped during the 1960s, and the statistical devices used (particularly the common usage of linear homogeneous production functions) probably still exaggerate the contribution of labor in general and education in particular.

10. Carl Auerbach and Frank Sorauf have taken this position in a University of Minnesota faculty seminar on equal opportunity and education.

11. More on education as investment and consumption: when my son Christopher got all A's in first grade but found school repressive and dull, the argument that his grades indicated a successful and lucrative future was little consolation to him or to me.

12. The term is from a paper of that name by T. Koopmans in *Review of Economics and Statistics*, August 1947.

13. See note 7.

14. See, for example, Theodore J. Lowi, *The End of Liberalism* (New York: W. W. Norton & Company, Inc., 1969).

15. Talcott Parsons, "The Academic System: A Sociological View," *The Public Interest*, Fall 1968, p. 176.

16. Perhaps this section should be entitled, "The university as non-bureaucracy," rather than "The university as non-organization," because faculty members are not organized in a hierarchical authority structure (part of Max Weber's classic definition of a bureaucracy). But the main argument of this paper is that for certain important purposes, faculty members act independently, not as members of the organization, the university. See Max Weber, *The Theory of Social and Economic Organization*, A. M. Henderson and Talcott Parsons (translators) and Talcott Parsons (editor), (Glencoe, Illinois: Free Press, 1947) pp. 329-336.

17. More extreme positions have been taken. One, any proponent of which probably would not bother to write such a paper as this, is that "prospective educational administrators should learn to be comfortable with one of the realities of human experience and one that Aristotle recognized; it is that one of their responsibilities is to provide optimum conditions for the intellectual life, *which may have no purpose beyond itself.*" (Emphasis added.) John Walton, "The Dissimilarity of Educational Administration," *Public Administration Review*, January-February 1970, p. 59.

18. The University of Minnesota has traditionally expected extension to be self-supporting (in operating costs); California stopped providing state funds for extension activities in 1968.

19. A former student of mine, Bryant Robey, made this argument in an elegant unpublished paper. In the paper he also questioned the advisability of the government's subsidizing its employees to return to school for such training. If the student becomes more valuable as a result of the training and gets a raise, then he is reaping the benefit and should pay the cost. If he isn't more valuable he shouldn't have gone back to school. Robey was analyzing the costs and benefits of the program which was supporting him! The paper is "The Educational Program in Systematic Analysis: An Economic Analysis," Department of Economics, University of Wisconsin, May 14, 1968.

20. The problem of pricing of joint products of universities is considered in Andre Daniere, *Higher Education in the American Economy* (New York: Random House, 1964), Chapter 5 and Appendix B.

21. See "Resources for Higher Education: An Economist's View," *Journal of Political Economy*, May-June, 1968, p. 332.

22. The university as haven or safety valve is another kind of public good. Presumably some persons outside academia who value academic freedom benefit by the realization that extreme statements and actions of academicians can occur without disrupting outside society.

23. For a discussion of pricing of public goods, see O. H. Brownlee and John A. Buttrick, *Producer, Consumer, and Social Choice* (New York: McGraw Hill, Inc., 1968).

24. W. Lee Hansen and Burton A. Weisbrod, *Benefits, Costs, and Finance of Public Higher Education* (Chicago: Markham Publishing Company, 1969). Joseph Froomkin has estimated that the major proposals for federal support to *institutions* of higher education would result in about four times as much money going to students from the upper income quartile as to students from the lowest quartile. Froomkin, *op. cit.*, pp. 11-12, and Chapter 8.

25. Besides, setting price considerably below cost presumably induces some people, for whom the benefits are less than the costs, to go to college. The inefficiencies of pricing at other than (marginal) cost are described eloquently in Daniere, *op. cit.*

26. Robert Holt has suggested to me that if the country were to move away from generalized subsidy of public higher education, thus diminishing the price differential to the student between public and private education, it would be proper to end the tax exemption of contributions to educational institutions.

27. And it is affecting public policy at least in California, Wisconsin, and Washington, D.C. In my opinion the work of Hansen and Weisbrod, *op cit.*, has had more impact on public policy for the financing of higher education than any other in recent years.

28. Washington University, St. Louis, Missouri, August 1963, mimeographed. Essentially the same material is included in B. A. Weisbrod, *External Benefits of Public Education* (Princeton, N.J.: Princeton University Industrial Relations Section, 1964).

29. Hansen and Weisbrod, *op. cit.*, p. 40. Milton Friedman has also had a change of heart on the matter of externalities of higher education, "When I first started writing on this subject, I had a good deal of sympathy with this argument. I no longer do. In the interim . . . I have tried time and again to get those who made this argument to be specific about the alleged social benefits. Almost always, the answer is simply bad economics . . . . Occasionally an answer is given that is good economics but unsupported by evidence." Friedman, "The Higher Schooling in America," *The Public Interest*, Spring 1968, p. 110.

30. " . . . had college schooling been as near universal in his time as in ours, Charles Alva Edison might well have ended up as a high-grade school or college physics teacher; current goings-on on campuses suggests (sic) that there may be negative as well as positive training for citizenship . . . ." Friedman, *op cit.*, p. 111.

31. *External Benefits . . . op. cit.*

32. It is interesting to note that my own activities as head of a School of Public Affairs include trying to persuade people in government to bestow funds on the School for student and faculty support in the "public interest." I can either recognize this as special pleading, inconsistent with the argument of this paper, or contend that current distorted societal arrangements leave me no alternative if I want to compete with other schools; or argue that those distortions prevent the School's outstanding faculty and graduates from being paid their marginal products and thus that they deserve subsidies. James Lyday has helped me with this casuistry.

33. People obviously get satisfaction from giving money to a favorite institution, particularly if in return their name is chiseled over a door. "Monuments" is Milton Friedman's term. See Friedman, *op. cit.*, P. 108.

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"Consider the economic rewards which flow to a recipient of a good education."

The Outputs of Undergraduate Education

ROBBIN R. HOUGH

Of apple picking: I am overtired
Of the great harvest I myself desired.
There were ten thousand thousand fruit to touch,
Cherish in hand, lift down, and not let fall.
For all
That struck the earth,
No matter if not bruised or spiked with stubble,
Went surely to the cider-apple heap
As of no worth.

"After Apple Picking," Robert Frost.

The literature on the economics of higher education does not dwell long on the institution of higher learning (IHL) as a decision-making and goal-seeking enterprise. It has been most fashionable to treat IHLs as black boxes into which inputs are poured and from which outputs flow.

It is a primary assumption of this paper that the IHLs of the nation are decision-makers in a fashion which makes them directly comparable to the firms of micro-economic theory. Like firms and consumers they are decision-making institutions possessing clearly specifiable goals and instruments for attaining those goals. They, too, operate in environments which constrain them and to which they react in ways which are predictable.

It is assumed that IHLs are institutions which, for a range of reasons, are operated by their faculties, but are subject to considerable constraints by administrative, student, trustee, and, in the case of public institutions, legislative constituencies. In consequence, the "behavior" of an IHL will be determined as a resolution of the sometimes conflicting goals of these several constituencies.

The purpose of the paper is twofold: (1) to define operationally some outputs of undergraduate education and (2) to explore briefly a model of IHL behavior which may throw light on important relations between the outputs defined and the inputs which give rise to them. In all, the paper is based on a commitment to cast IHLs into the mold of a different perspective. It is a paper to be mused rather than digested for immediate action.

A Faculty View

From the point of view of a college faculty, treated as a unit, three categories of output will receive consideration. These categories are educational outputs, change, and outputs which contribute to professional advancement and recognition.

Reliable Measure Lacking

A primary problem in the study of undergraduate education is the lack of a consistent and reliable measure of the quality of IHL output. Ideally, such a measure would relate to the long-run performance of the graduate beyond the campus. The development of such a measure will be discussed in the next section of this paper. Lacking such a measure, a means for making limited inter-institutional comparisons is available by distinguishing between three categories of student outcome. Dropouts are, of course, students who begin but never complete work on a baccalaureate degree. It is useful to distinguish between two types of students who do go on to complete their degree work. The general idea involves distinguishing between those students who meet the formal requirements for a degree and those who are singled out by the faculty as meriting special care, attention, and/or commendation. The latter will be called "apples" throughout the remainder of the paper.

As applied to a given IHL, the term "apples" will be defined as those baccalaureates from the IHL who go on to receive doctorates and to those doctorates produced by the IHL. Several justifications underlie the consideration of these specific groups as they relate to institutional quality. First, in an educational setting, the purview of a given faculty is limited, and special attention can be paid to a limited number of students, be they graduate or undergraduate students. Secondly, despite objective testing, the evaluation of student performance is still a strongly subjective matter. In the case of "apples," the judgments of an undergraduate faculty have been confirmed (in some sense) by the judgments of a graduate faculty. Finally, the measure allows the somewhat evenhanded comparison of undergraduate with graduate institutions. In connection with this final point, preliminary work with the measure suggests that the measure produces a rank-ordering of undergraduate institutions which is consistent with the folklore on academic quality. An examination of this measure in comparison to other measures is under way.

Based on the numbers of baccalaureates who go on to receive doctorates, there are considerable quality differences among undergraduate programs. On average, about .4 "apples" were produced between 1958 and 1966 for each degree granted in 1967 by 75 of the largest undergraduate "apple" producers. However, the ratio of apples to degrees ranged from a low of .08 to a high of 2.63 (National Academy of Sciences, 1967, and HEW, 1967). The twenty largest doctorate-producing institutions over the period had a total combined undergraduate enrollment of 288,477. They produced a total of 21,484 baccalaureates who went on to receive their doctorates during the period. The four largest doctorate producers had a combined undergraduate enrollment of 69,744 and produced 6,233 baccalaureates who received doctorates during the period. The twenty institutions with the highest ratios of "apples" to degrees had combined undergraduate enrollments of 56,969 in 1967 and produced 11,921 baccalaureates who went on to receive doctorates. The four with the highest ratios had 8,337 undergraduates and produced 3,253 who went on to receive doctorates.

The largest producers of baccalaureates who later receive doctorates and those producers with the highest ratios of undergraduate "apples" to baccalaureate degrees are quite different. The largest producers include a number of public institutions. The institutions with high ratios are private, relatively small, have low student-faculty ratios, demand high admissions scores, and pay high faculty salaries.

The relations between the degree recipients, "apples," and dropouts will be discussed in a later section of the paper. Let us now turn to the discussion of a second type of output.

Centers of Change

Though they may be so only in the minds of their faculties, IHLs have often been thought of as centers of change. In an attempt to consider the full range of IHL outputs, some attention should be given to the role these institutions play in the diffusion of technical and cultural changes.

A curriculum, in part, reflects the conceptual structures of the era in which the IHL operates. To some extent such changes may be transmitted directly to students. More importantly, for the student, contact with the university evironment may partially legitimize the personal innovations which he or she undertakes. It may be that major cultural innovations are transmitted in a less direct fashion. In such a view, the IHL may be thought of as the force for stimulating interregional flows of students, faculty, and information through which innovations are diffused. It may prove possible to study the impact of these flows by examining the spread of particular innovations, such as underground movies, coffee houses, fashions, and the like.

In spite of grumblings over the inequities of the "publish or perish" system, scholarly output continues to be one of the few explicit measures by which faculty performance is allegedly judged. Presumably, it will continue to be a useful index.

Output as measured by books, articles, and the like does not adequately capture what might be called the storage and dissemination functions performed by faculty. Investigators in the information sciences have long been aware of the numerous informal channels of communication which connect the researchers in disparate geographical centers (Garvey and Griffith, 1964). The public affairs and consultation activities of faculty link the formal and informal communications channels to society at large. By participation in these activities and by teaching, the faculties perform communication and the dissemination functions. A study of the extent, variety, and dollar volume of faculty consulting might help in the understanding of these functions.

As mentioned above, much depends on the development of an adequate measure of teaching effectiveness both at the inidividual faculty level and at the institutional level. From no point of view is the question more important than from that of the student.

A Student View

This section will be concerned with the questions of intellectual value-added and economic rewards. Topics will be treated in turn, though there are important overlaps between them.

Support for educational research doubled between 1960 and 1965. Our failure to provide an acceptable understanding of what education has done and is doing for the young people of the nation is probably related to the fact that only .22 per cent of the total budget for education was spent on educational research. While it may help somewhat to understand the determinants of "apples" production, students are beginning to ask for much more specific justification of the curricular tasks they are asked to carry out. In order to provide these justifications, it would seem that measures of intellectual value-added, more promising than those in use, must be developed. The problem is well stated by Bennett.

> To justify transferring the IQ to fields of human endeavor other than the psychological laboratory it would be necessary to show how it co-related not only with scholastic performance but also with practical life achievement. A great deal of work has been done in this field, and it is generally agreed that the quantity measured in an intelligence test is strongly co-related with scholastic achievement. The evidence of co-relation with life achievement is very much weaker. This can be accounted for if we assume that intelligence is an organized "something" in man that determines his ability to perform operations of a certain kind, but that there are other systems that play a less well-defined but no less important role (Bennett, 1969).

There is a line of research which it might be of some use to consider in pursuing the quantification of these particular educational outputs. In the writer's modeling of the university classroom, the distinction between a student's information-processing capacity and memory capacity became quite useful (Hough, 1968). For those comfortable with the analogy between a computer and a human, the distinction between the central processor capacity of a computer and its memory capacity is a useful analogy. A recent discussion by Cronbach specifies a similar distinction, though he specifies the use of memory capacity rather than its size.

> On the scientific side, it is vital to break away from such terms as "intelligence" and "learning ability." There is a spectrum of performance ranging from crystallized, over-learned routines to fluid information processing, often referred to as g. Fluid ability is measured in tests like the maze, the matrix or figure analogies, block design, and embedded figures. Jensen's Level II abilities involve it. Crystallized abilities are diverse and specific: spelling of -gn words, handling of subjunctive clauses, etc. In schools as they now are, success is best predicted by taking an inventory of relevant crystallized abilities with which the student starts the year. The verbal "intelligence" test succeeds as a predictor primarily because it reflects concrete achievements. A child with average fluid ability and low crystallized ability is likely to do poorly; we have never succeeded in devising a mass educational program in which such a child is likely to achieve average success. Analytic ability should be a resource on which education builds, and as of now it is not (Cronbach, 1969).

Perhaps even more so than in elementary and secondary education there is a tendency for the undergraduate classroom to place reliance on a stock of crystallized abilities which the student is supposed to possess or be able to acquire quickly. If the student has not acquired or has limited capacity to store crystallized abilities, difficulty will surely arise. There is indeed some evidence that undergraduates with relatively low crystallized abilities have a relatively high dropout rate, even when their fluid processing abilities are extraordinarily high.

To the extent that students differ considerably in their possession of these abilities, their responses to particular environments for learning may differ significantly. Some rather too casual evidence from the writer's classroom experience tends to link relatively strong endowments in either direction with distinctly different learning styles. Students who display relatively high levels of fluid processing ability tend to react to classroom situations by describing themselves as "bored." Their colleagues with relatively high endowments of crystallized skills tend to describe themselves as "tired" under similar circumstances. A belief in comparative advantage has led the writer to conclude that those with fluid processing ability seek "concepts" which they can apply and are "bored" with an environment in which they are asked to listen to numerous facts. Those students with crystallized abilities try to remember all that is being put forth, and they are seldom able to keep up with the rate at which the environment of a classroom produces information.

Careful study and definition of fluid processing or crystallized abilities, as they relate to specific courses of study, would do much to clear the way for more adequate measurement in these areas. For example, the process of "doing" economics may be caricatured as accepting inputs, processing those inputs, and writing articles for the literature on economics. To the economist, the inputs are observations of behavior and measures on the observed behavior. Within the "black box," models of the observed behavior are constructed and derived hypotheses tested against the measures. Can the crystallized skills necessary to the *doing* of economics be inferred from the output of the economist? Are the concepts used to write about economic behavior in one-to-one correspondence with those crystallized skills? What level or range of fluid abilities is required? What special subset of analytic concepts could be useful for students with a relatively low capacity for retaining crystallized skills?

Skinner seemed to have been on the right track when he wrote:

> A much more promising approach is to look at the student's behavior — the behavior from which mentalistic states and processes are inferred and which they so inadequately describe and explain. The basic question, in its crudest form, is this: *What do we want the student to do as a result of having been taught*? (It is no answer to cite examinations he is to pass, for they are only samples of his behavior, and no matter how reliable they may be, they are, we hope, very small samples indeed of what he will actually learn.) To say that we want the student to "behave like a scientist" is on the right track, but it is only a start. For how does a scientist behave? The answer will be nothing less than an epistemology, a theory of scientific knowledge. It must in fact be more: We need an empirical description of the behavior of the scientist at work, in all its myriad forms (Skinner, 1968).

Consider the economic rewards which flow to the recipient of a good education. Considerable attention has been paid to education as investment in human capital. Most of that has been focused on the returns to the individual as a participant in and contributor to the process of economic growth. Much excellent work has been done in that area. It does not seem appropriate to review that work here except perhaps to note that it would be highly useful to continue studies of the type undertaken by Hunt in which the focus is on the factors which contribute to individual differences in the rates of return (Hunt, 1963). There are two labeling or sorting processes accompanying undergraduate education which deserve further attention. Graduates are labeled as a product of their *alma maters* and are given degrees which correspond to particular compartments within the institutions they attended. It is not clear that the labeling which goes on in the context of undergraduate education is an unqualified economic benefit from that process. While it may prove to be of short-run use to both the graduate and his employer, the existence of the strong occupational stereotypes pointed out by Beardslee and O'Dowd may serve in the long run to reduce substantially the individual's perceived mobility and, thus, his actual mobility (Beardslee and O'Dowd, 1962).

There is an additional question which must be raised from the student's point of view.

> Though Schultz recognizes that a part of the education given and received is really a consumer good, he does not separate that part from the total capital formation by education. It might be argued that even though there is some education that is essentially used as a consumer good, it could yield productive services, just as the education intended primarily to form human capital does. Therefore it, too, should be added to the capital stock created by education. This addition would be hard to justify, however, in the face of the well-known differences in the returns from different kinds of education (Eckhaus, 1962).

Is Eckhaus correct, or do we simply fail to account for a substantial economic benefit which, in fact, might be measured?

Consider consumer goods and an individual's time as factors of production in a production process, the output of which is the " . . . restoration of a depleting psychic capital." (Utility?) Boulding suggests that there are two dimensions to such a product:

> Thus, I have argued that we go to a concert in order to restore a psychic condition which might be called "just having gone to a concert," which, once established, tends to depreciate. When it depreciates beyond a certain point, we go to another concert in order to restore it. If it depreciates rapidly, we go to a lot of concerts; if it depreciates slowly, we go to few . . . .
>
> Further interesting problems are raised by the demand for variety. We certainly do not want a constant state to be maintained; we want fluctuations in that state. Otherwise there would be no demand for variety in food, for variety in scene, as in travel, for variety in social contact, and so on (Boulding, 1966).

Changes in the wage rate of the individual (i.e., the price of his time), relative to the prices of the other factors used in the "psychic production function," will affect their relative employment in the restoration of psychic capital. The higher the price of consumer-good factors, the greater the tendency to employ "do-it-yourself" methods to restore psychic capital. Similarly, the higher the wage rate of the individual, the greater the employment of consumption goods. Mincer has studied the income elasticity of demand for domestic help using a similar formulation (Mincer, 1963). Thus, family members and domestic help were viewed as factors of production in the household. The failure to include the female wage rate as an opportunity cost variable resulted in biases in the income variable of more than 50 per cent. The studies of the role of education to date have simply concerned themselves with the effect of education on the wage rate. If the formulation above is considered, the acquisition of crystallized abilities and the improvement of fluid processing abilities may be seen to affect *both* the wage rate and the production function itself. The effect of certain skill acquisitions on the production function may more than offset the increase in consumption brought about by the higher wage rate returned to the skills. Indeed, this "busman's holiday" effect may, in part, be responsible for the observed relationship between savings and income.

A Public View

An enumeration of the outputs of higher education which dominate the public view these days will be foregone on the grounds that these eddies in the serene pools of academe are but short-run costs of long-run progress. Hopefully, someone can supply historical justification for such a view.

The economics of education resemble nothing so closely as the economics of a world fair. That is to say, it is very difficult to make ends meet in the day-to-day operation of the IHL, but benefits from its existence are reaped much as they are reaped by every merchant within miles of a fair site.

The gathering together of the human resources necessary to produce a particular type of undergraduate education makes possible the presentation of a number of other types of program. Among

these would be institutes, seminars, training programs, and the like. The teaching, administrative, and technical personnel of IHLs often take difficult and time-consuming tasks as community leaders and consultants. The specialized physical facilities of these institutions are often made available for public use. A part of the cultural impact of an IHL can be seen to operate in the areas of audience development and spectator sports. It is well to recall the observations of Carl Kaysen:

> (1) Since institutions of higher education produce multiple products with partly overlapping and partly different users, it is important for them to learn what their product mix is, who in fact are the beneficiaries of particular products, and, so far as possible, what are the separate costs of producing each output.
>
> (2) Some beneficiaries should and may be expected to pay the "full costs" of the particular outputs they use, and, in fact, prices to them may appropriately be higher in relation to directly assignable costs than for others. Some types of output benefit the community as a whole so much and particular individuals so little, as to make it both inappropriate and infeasible to expect to charge them on a cost basis. Thus, a combination of inter-product price discrimination and a flow of receipts not contingent on the "sale" of a particular sort of output is indicated (Kaysen, 1960).

Most of the products above are individually identifiable, and at least something like full-cost pricing is employed by many IHLs.

A number of effects will identify the IHL as a producer of externalities. The costs for the production of these particular benefits are, of course, not easily assignable. Some of them may be measurable.

It is of considerable importance in these times that an IHL is a pollution-free institution. Further, to the extent that many IHLs are desirable neighbors, they may have a considerable impact on the property values in the area surrounding their campuses. The techniques utilized in the study of land value gradients around city parks might be employed in order to estimate this particular range of outputs. In a similar fashion, some in a community may benefit at the expense of others, insofar as IHLs attract a relatively high-income population to the area surrounding them and simultaneously drive away low-income residents. Again, local communities may benefit from the considerable stimulus of the spending of faculty and students as well as from higher income and property tax revenues.

To some extent, earning differentials among individuals who are going to college and those who are not are based on ability. The provision of a draft sanctuary of IHLs to an extent which is estimable reduces the costs of the military draft. There also seems to be at least a modest tendency for university enrollments to be counter-cyclical in that young folks who might otherwise be unemployed utilize slack periods in the economy to increase their education. The option to continue in the educational system slows the rate of entry of a given cohort into the labor force and disperses the cohort in ways which may be advantageous to society.

Finally, the presence of a faculty usually exerts a strong influence for improvement in a community's school system. It may further serve as an attraction to light pollution-free industrial enterprises. In both cases, there are gains which are clear in concept to the public.

A Private Industry View

As with the public outputs, there is a range of externalities which relates the IHL to the private sector. Insofar as an IHL community is a relatively attractive community, firms may find it easier to recruit employees to live in the community. IHLs make available a large pool of part-time labor of an unusually high quality. In a similar vein, it might be expected that the sorting and grading process which a given institution performs at a point in time is reliably related to the job which it does at a later point in time. Thus, IHLs become reliable sources for employees of a given quality.

Also, as with public outputs, there are many joint products which are probably paid for at something close to their "full costs." Faculty consultants are hired, personnel are asked to serve, facilities are hired, and the usual range of curriculum-related programs is made available to employers.

The IHL As a Decision-Making Institution

The marketplace in which IHLs operate may now be defined in terms of the supply of and the demand for degrees. That is, the outputs discussed above point to the role of the educational institution as a certifying, or legitimizing, institution. The degrees, course certificates, consultations, leadership roles, and labeling are all subject to the certification or legitimization interpretation.

The "firm," then, might be said to produce in a market in which degrees are supplied and demanded. In the sense that "profits" earned may be "plowed back" to improve the "quality" of production or increase institutionally supported research, these firms may be said to maximize profits.

As in analyses of the industrial marketplace, the analyst may be concerned with questions of (1) the degree to which the profit-maximizing model

"explains" the behavior of IHLs, (2) the structure and performance of the industry, and, finally, (3) the policy implications of the model. The remainder of this paper will examine some preliminary findings which bear on these questions.

Educational "production functions" are commonly used to relate characteristics of incoming students to the characteristics of outgoing students. The depiction of the university as a certifying and legitimizing institution suggests that there is a more direct analogy to the firm of micro-economic theory.

In the sense in which it will be used here, the "production function" of the IHL relates student and faculty inputs to degree-holder (or certification) outputs. The "technology" under consideration may be thought of as determined by (1) admissions standards, (2) curriculum requirements, (3) the "technology" of classroom teaching, and (4) IHL degree requirements. Significant changes in any of these four factors may be thought of as engendering shifts in or distortions of the entire production surface.

Assume that the primary outputs of the instructional process are degrees and that students and faculty are the only required inputs. The results of fitting a Cobb-Douglas-type function to 75 of the 100 largest producers of baccalaureates who went on to receive doctorates are found in Table 1. In that table, the dependent variable is the number of degrees produced in 1967, variable 01 is the total enrollment in 1967, and variable 02 is the number of full-time professional employees employed in the fall of 1966. All three variables are expressed in log form.

TABLE 1

STD ERR Y.X = .18399
R SQUARED = .94002
SUM SQR RES = 2.43760
IND VAR USED = 002
TERM = -.68251

VAR	COEF	STD ERR	T RATIO
01	.74705	.03900	19.15390
02	.19289	.04055	4.75601

The relevant production function may thus be estimated as:

$$D=.5053\ F^{.19}S^{.75}$$

As estimated, the IHLs involved exhibit decreasing returns to scale. That is to say, the sum of the coefficients of the function is somewhat less than 1. Decreasing returns in the university context are subject to an interesting interpretation. So long as an institution is small, fairly wide variations in the ratio of enrollees to faculty members will not dramatically affect the number of degrees granted per enrollee (the average productivity of enrollees). However, as the enrollments of the institution increase, to reduce the student-faculty ratio to offset the declining average productivity of enrollees requires student-faculty ratios which would be exceedingly hard to attain on the scale required.

Table 2 contains the expected ratio of students to degrees (the inverse of the average productivity of students) for enrollments at the level of the ratio and enrollments at size 30,000.

TABLE 2

Student-Faculty Ratio	Enrollment at the Level of the Ratio	Enrollment at Size 30,000
10/1	3.52	5.69
15/1	3.90	6.15
30/1	4.64	7.01

These ratios may be compared with an "idea ratio" of 4.0 for a four-year undergraduate institution.

There are considerable variations in the average productivities observed among the 75 institutions studied. Their inverses range from a low of 3.8 to a high of 11, with a mean of about 6. The sources of this variation include program mix and the number of part-time students, as well as the scale of the institutions; however, scale effects do account for a considerable share of the variation observed.

The effects of scale become much more pronounced if students are distinguished according to their status as graduate students, undergraduate students, part-time students, and full-time students. The estimation of a Cobb-Douglas function which included the five factors of production yielded:

$$D=2.59\ U_f^{.52}G_f^{.13}G_p^{.05}F^{.13}U_p-.008$$

$$R^2=.903$$

where U_f =full-time undergraduates, G_f =full-time graduate students, G_p =part-time graduate students, F=full-time professional staff and U_p = part-time undergraduates. The sum of the coefficients is .81, indicating decreasing returns to scale. The very small and insignificant coefficient of part-time undergraduates suggests that these undergraduates experience considerable difficulty in completing their degrees.

Two factors, among others, will make difficult the development of adequate estimates of IHL long-run cost functions. First, the students are not only factors of production, but they provide significant fractions of the demand for degrees. Secondly, factor price indexes and cost information by institution are not easily obtainable. As an examination of state expenditures on higher education shows, costs are strongly related to degree production and, thus, indicates that further analyses would be worthwhile. Examined by state, 96 per cent of the variation in the sum of administrative, instructional, maintenance, and library expenditures is explained by the total number of degrees produced in the states. The estimate, based on 1963-64 expenditures and degree production in 1967, suggests that $6,329 in these expenditures are made for each degree produced.

The most important implications of these observations for the further study of IHLs relate to the optimal size of IHLs and the probable explanation of their behavior as decision-making units. The remainder of the present section will focus on institutional size and the following section will briefly examine IHLs as decision-making units.

The production function estimates, above, provide frameworks within which to consider university size as it relates to costs of degree production, the demands for university outputs, and the idea of an optimal size university. The time available for the preparation of this paper did not allow a full exploration of the above matters. However, several preliminary observations can be made.

The choice of an optimal input mix is not fully within the control of an IHL, since the supply of student factors and the demand for the product are not independent. However, given a total budget and a faculty price, there is a degree-maximizing level of student enrollment for each price which might be placed on the student factor.

Table 3 contains calculated cost and productivity information for two budget sizes ($50,000,000 and $100,000,000) and several student prices. In order to produce the table, the production function $D=.5053F^{.19}S^{.75}$ was maximized, subject to the constraining budgets for each assumed student price. Three features of this table are of interest.

While there are decreasing returns to scale evident, the computations suggest that the scale of an IHL is not nearly so important as the level of the student-faculty ratio. Thus, in each case, input can be nearly doubled without significantly affecting costs per degree or the total output of degrees. On the other hand, degree costs rise rapidly as the student-faculty ratio is lowered. Optimality then, from a strict factor cost standpoint, is to be understood in terms of the student-faculty ratio and not in terms of the scale of the institution. If the second of the two functions estimated above is explored, preliminary analyses suggest that scale is of sufficiently greater importance as to cause concern. Unfortunately time did not permit a full exploration of the function.

A reduction in the student-faculty ratio as shown in Table 3 brings about a concomitant reduction in the number of students per degree. If the student's time is valued at about $8,000 per year, the increase in costs per degree incurred by reducing the student-faculty ratio from 22 to 1 to 16 to 1 is nearly offset. This observation suggests that an optimal student-faculty ratio lies in the neighborhood of 18 to 1.

"Technology" was defined earlier as a set of institutional arrangements by which student and faculty inputs are converted into degree outputs. The foregoing analysis suggests that *at best* the structure of the existing arrangements may hold degree-seekers in the system for nearly six years. The question may be raised as to which institutional arrangements relate to the extension of queues of degree candidates. One's interest in the question is further enhanced on finding that there is a strong relationship between student productivity and the quality of the product as measured by "apples" as a decimal fraction of degrees. In Graph 1 the number of "apples" per degree is plotted against the number of enrollees per degree for most of the largest 100 producers of "apples." The relationship suggests that the same factors which are responsible for increasing the time required for a student to complete a degree are responsible for the decline in the quality of production. The chief factor leading to declining productivity and quality has been related to the technology of IHLs. However, the behavior of IHLs in internal-resource allocation cannot be dismissed as contributing to declining student productivity. The market behavior of IHLs will be examined in the following section.

TABLE 3

C = TOTAL BUDGET
D = DEGREES GRANTED
S = STUDENTS
F = FACULTY

C	D	C/D	S	F	S/D	S/F
STUDENT FACTOR PRICE = 750						
50000000	6319.2	7912.39	53191.5	811.171	8.41744	65.5737
100000000	12123.6	8248.4	106383.	1622.34	8.77489	65.5737
STUDENT FACTOR PRICE = 1500						
50000000	3757.42	13307.	26595.7	811.171	7.07819	32.7868
100000000	7208.72	13872.1	53191.5	1622.34	7.37877	32.7868
STUDENT FACTOR PRICE = 2250						
50000000	2772.18	18036.4	17730.5	811.171	6.39587	21.8579
100000000	5318.5	18802.3	35461.	1622.34	6.66747	21.8579
STUDENT FACTOR PRICE = 3000						
50000000	2234.18	22379.6	13297.9	811.171	5.95203	16.3934
100000000	4286.33	23330.	26595.7	1622.34	6.20478	16.3934
STUDENT FACTOR PRICE = 3750						
50000000	1889.88	26456.7	10638.3	811.171	5.62908	13.1147
100000000	3625.79	27580.2	21276.6	1622.34	5.86812	13.1147
STUDENT FACTOR PRICE = 4500						
50000000	1648.35	30333.4	8865.25	811.171	5.37826	10.9289
100000000	3162.4	31621.5	17730.5	1622.34	5.60666	10.9289
STUDENT FACTOR PRICE = 5250						
50000000	1468.38	34051.1	7598.78	811.171	5.17494	9.36767
100000000	2817.13	35497.1	15197.6	1622.34	5.3947	9.36767
STUDENT FACTOR PRICE = 6000						
50000000	1328.45	37637.9	6648.94	811.171	5.00504	8.19671
100000000	2548.67	39236.2	13297.9	1622.34	5.21758	8.19671

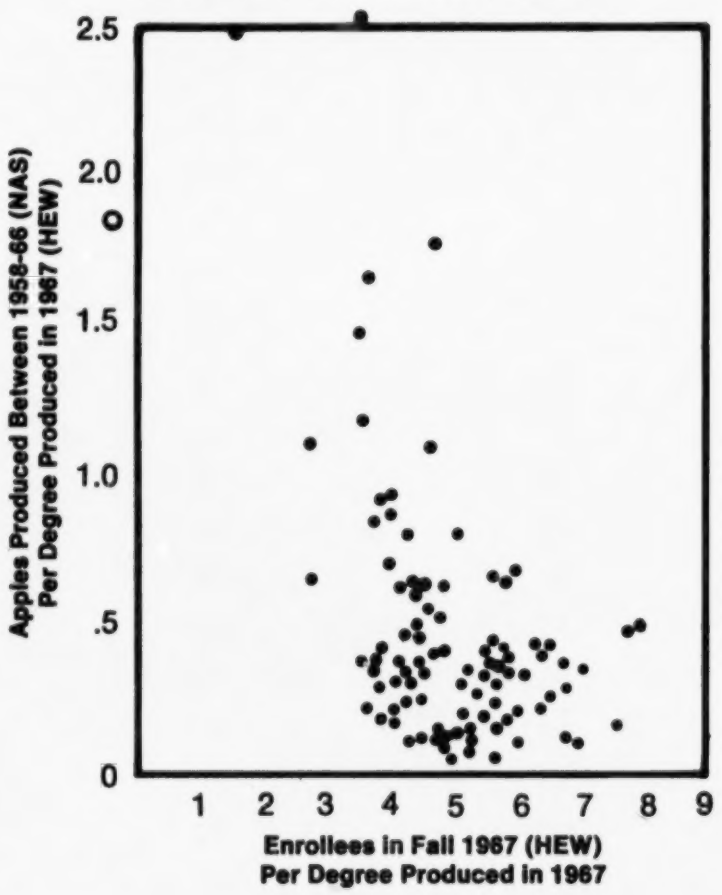
Some Aspects of Life in the Market Place

Inferences about the goals of colleges and universities can be made from an examination of the work of Allan Cartter and others who have attempted to determine pecking orders of IHLs (Cartter, 1966). By asking faculty, alumni, and others and by examining the distribution of awards to various institutions, these authors have been able to provide rank-ordered lists of institutions which are fairly consistent with one another. A superior position on these lists is associated with such amenities as superior library facilities, higher faculty salaries, more Woodrow Wilson fellows, and higher freshman entering SAT scores. Studies which ignore the capacity of IHLs to pursue these goals seem likely to fail in their attempt to improve our understanding of the educational enterprise.

It was remarked at the beginning of the previous section that an IHL might be characterized as a profit-maximizing institution, insofar as it may restrict its output, raise its price, and plough back profits from tuition into "apple" production and research.

Table 4 contains the 1963-64 current fund income for higher education in the 16 states dominated by the largest 27 "apple" producers. As may be noted in Column 3 of that table, 83 per cent of the federal research fund income received by universities was concentrated in those states. Thus, in addition to producing "apples" some considerable share of their output must be thought to be

GRAPH 1. RELATIONSHIP BETWEEN "APPLES" PER DEGREE AND ENROLLEES PER DEGREE FOR SEVENTY-FIVE INSTITUTIONS

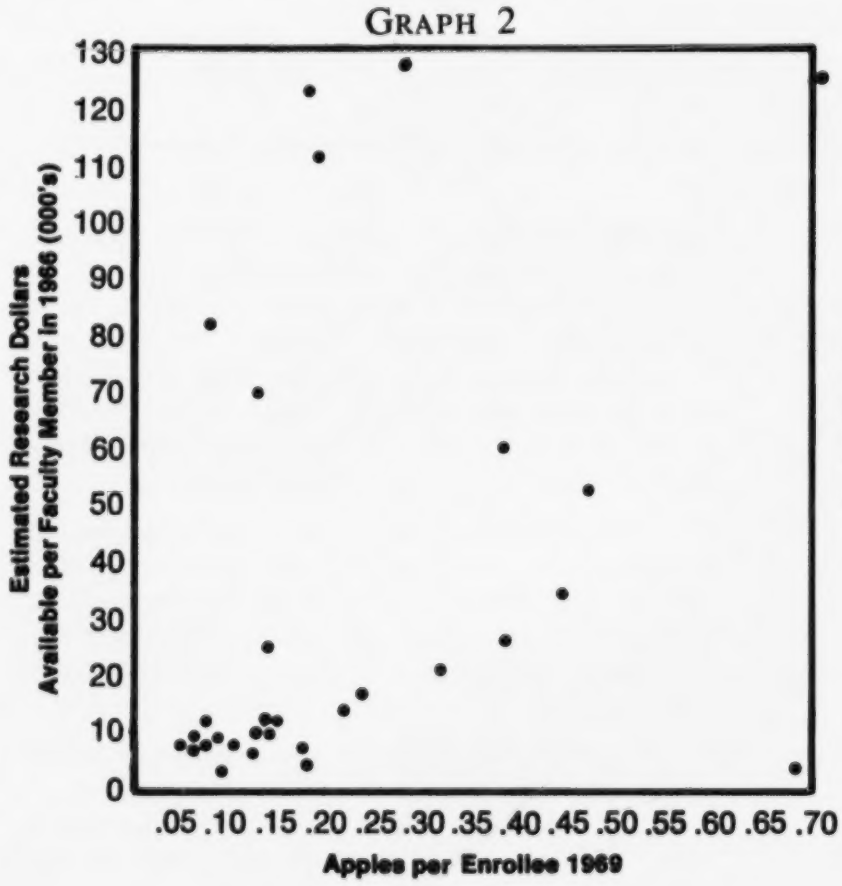

Apples Produced Between 1958-66 (NAS) Per Degree Produced in 1967 (HEW)
2.5
2.0
1.5
1.0
.5
0
1 2 3 4 5 6 7 8 9
Enrollees in Fall 1967 (HEW) Per Degree Produced in 1967

pure and applied research. That additional output, of course, must be included in the computation of their value-added. However, the impact of those research activities on student productivity of the institutions must be considered. It is not clear that in all cases faculty are able to make these outputs complementary.

Graph 2 illustrates the impact of research-fund availability on the composition of production among the 27 major institutions in those states. The estimated funds available were based on a 10 per cent return to the universities' endowments and their share of federal research funds as estimated from their share of the state output of doctorates. The resulting graph suggests that, as higher levels of research funds are made available to faculty members, they switch from the teaching of undergraduates to research and the production of "apples." The outlying observations are a special case in which the level of state support is a dramatically reduced fraction of the total support available to the IHLs.

Graph 3 shows the relationship between enrollees/faculty member and "apples"/enrollee. The 27 institutions under discussion are circled. It may be thought that some of these institutions attain high levels of "apple" output by holding down student-faculty ratios. Among some others, student-faculty ratios have not been maintained at sufficiently low levels to explain the results. For the

GRAPH 2



GRAPH 3

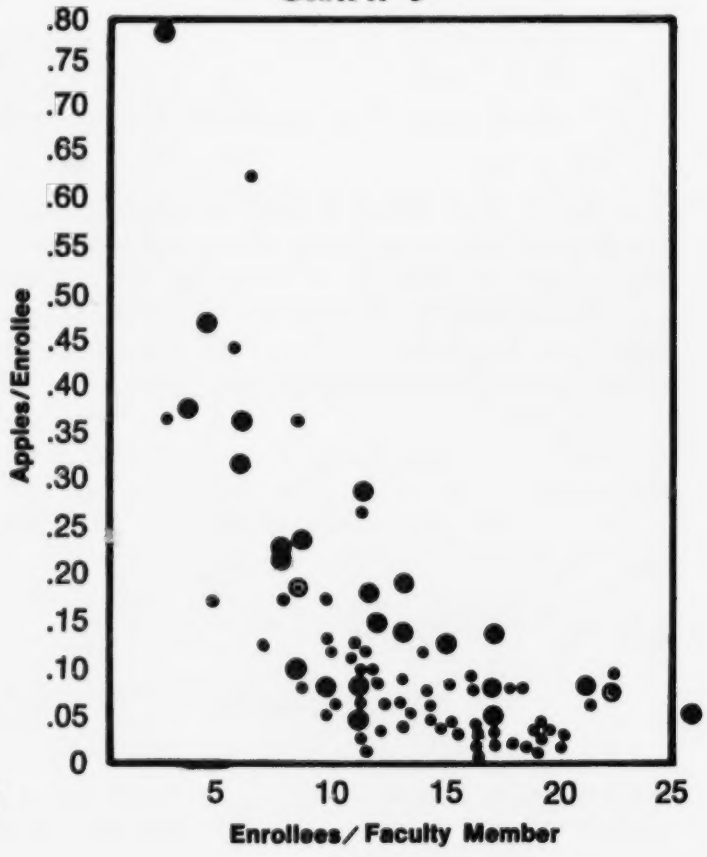


TABLE 4. 1963-64 CURRENT FUND INCOME TO HIGHER EDUCATION

State	Total Current Fund Income (000,000's)	Income From Federal Research (000,000's)	State Government (000,000's)
California	1,432	628	304
New York	981	172	135
Illinois	598	153	142
Massachusetts	531	184	21
Pennsylvania	499	62	69
Michigan	396	51	117
Indiana	266	21	74
Texas	360	32	111
Ohio	381	36	58
Wisconsin	189	20	49
Connecticut	132	20	19
Iowa	172	17	48
New Jersey	186	33	35
Minnesota	188	19	48
Washington	161	26	67
Missouri	192	19	43
Sub-total	6,000	1,493	1,240
U. S. Total	9,591	1,797	2,134
Sub-total as a Percentage of U. S. Total	71	83	58

latter set of institutions, it must be concluded that "apples" are being produced at the expense of prolonging the enrollment of ordinary undergraduates. Undergraduate productivity at these institutions also suggests that *internal* student-faculty ratios work against undergraduates. Thirteen of the 27 institutions circled in Graph 3 had more than six full-time undergraduates for each baccalaureate degree granted in 1967. One institution had more than eight full-time undergraduates for each B.A. granted and three had between seven and eight. In all, these facets of university behavior are strongly deserving of further study.

The Conclusion

A range of outputs of IHLs has been identified and preliminary models tested. In particular, the analogy between the form of micro-economic theory and IHLs has been considered. While the approach seemingly ignores the educational outcome of the particular student, it does stress the technological limits within which such outcomes are generated. It will be necessary to examine both the analogy and the data much more closely before reaching more than the most tentative conclusions. However, several observations are in order.

First, the model suggests that degree output and projected degree output (in the case of growing IHLs) are useful and important measures of institutional size. Indeed, the use of enrollment figures alone may generate highly misleading conclusions.

Secondly, the nature of the experience of students, who remain in a baccalaureate program for a number of years, should be closely examined in order to more fully illuminate the nature of stu-

dent productivity. The "slippage" which appears in response to increasing student-faculty ratios may have little to do with the content of the program. That is, a kind of reverse "Hawthorne effect" may be responsible for declining productivity. If such an effect is operant, significant increases in the student-faculty ratio as a part of "open enrollment" programs and the like would only serve to increase campus tensions. It must be noted in this regard that there are few, if any, institutions with low average entering freshman SAT scores *and* low student-faculty ratios. The final outcome of an experiment which dramatically changes IHLs in this regard is by no means clear.

Finally, it is clear that the student demand for degrees must be carefully studied. The time cost of choosing an institution with a high student-faculty ratio can be considerable. The job market would surely value the time of able students differently than the time of their less able counterparts. A failure to consider student reactions to the counter-pulls of market and social forces could result in difficulty for IHLs.

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"Decisions with respect to graduate education may be made at various levels. There are decisions at the national and state levels concerning the establishment of new institutions and new programs and the expansion or elimination of existing programs. Should a new Ph.D. program in African Studies be approved or a new medical school established? Individual institutions must choose between alternative strategies and alternative programs. Can a university justify its use of resources in Astronomy or Southeast Asian Studies, given the outputs, costs, and alternative demands for scarce resources?"

"Was the post-war emphasis in the United States on science and on the training of college teachers with the Ph.D. at the expense of the professions a wise allocation of resources?"

"The completion of some degrees, such as the LL.B., M.D., or Ph.D., may have more significance than the completion of the M.A. or M.S. degrees, since in some institutions the latter degrees are awarded as a consolation prize or as a step on the road to a Ph.D."

Outputs of Higher Education: Graduate Education

JOHN PERRY MILLER

The Task

The assigned task is to define the processes and products of graduate education in significant and operationally measurable terms. The stated motive is the hope to improve " . . . decisions governing the allocation of resources in colleges and universities." i.e., to identify better choices between the alternatives open to decision-makers. We are " . . . urged to consider the outputs of higher education in the broadest sense . . . . No attempt to limit the characterization of outputs to the economic sphere alone is either intended or desired." Moreover, while we are asked to concentrate on the " . . . output of the university viewed as an entity, rather than . . . each department or other small unit," we were not explicitly confined to identifying "final" outputs or precluded from measurement of "intermediate products."

Perspective

The objectives of our educational system are many. They include the development of values and character and the general socialization of the individual, in addition to the acquisition and dissemination of knowledge and the education of manpower with advanced and professional skills. The outputs are, consequently, multiple and generally "joint-products" in the economic sense. In the present state of knowledge, it is questionable whether objective and meaningful measures can be developed for some of the important outputs of higher education. Therefore, responsible decision-makers must rely in part upon their judgment and that of others concerning the reality and importance of some such outputs and weigh these in the balance with other outputs that are subject to more objective and meaningful measures. Judgment, intuition, and faith play an important part in most decisions, both private and public, but they are especially important in the case of decisions concerning education in which "public" benefits, in contrast to private benefits, bulk so large.

It is important to recognize that the development of some types of operational measures of the output of education *may* have effects on the educational process and therefore upon the outputs themselves. For example, nationwide or statewide tests may become ends in themselves and therefore bias or warp the educational process, if they are thought to have consequences for the students, teachers, or administrators. Not infrequently, students are trained to do well on the tests at the expense of other values of education that are not measured by the test, because the student wishes admission to further study or the teacher gains recognition by the record of his students on the tests. Such problems may arise, not so much from the nature of the measure as from its perceived use. The problem of evaluation is one of defining the objectives of the educational program and devising systems of evaluation that determine the extent to which the objective is attained, while reinforcing the incentives to pursue the desired ends. For example, a system of budgeting that is tied rigidly to the number of credit hours may provide an incentive to increase enrollment. Or a system based on degrees awarded may affect the level of achievement required for the award of degrees. Both systems favor "popular" fields of study and work to the disadvantage of the less popular or more "exotic" areas of study.

The danger that these measures may be counter-productive must be weighed against the disadvantages of having no measures. The resources available to education are necessarily limited, and higher education must compete with other claims upon limited resources. Decisions will be made at the levels of the nation, state, educational system, and college or university. Decisions based upon knowledge, including knowledge reflected in measures of output, made by persons of good will and good judgment, are likely to be better than decisions made in the absence of knowledge. Such knowledge may, of course, be misused by persons of ill will or bad judgment. But this is a problem not for those concerned with devising measures, but for those responsible for establishing and staffing the decision-making process, i.e., those who use the measures. Knowledge without a rational decision process, staffed by persons of integrity, gains us little. Conversely, a rational decision-making process, appropriately staffed, presupposes relevant knowledge.

Decisions with respect to graduate education may be made at various levels. There are decisions

at the national and state levels concerning the establishment of new institutions and new programs and the expansion or elimination of existing programs. Should a new Ph.D. program in African Studies be approved or a new medical school established? Individual institutions must choose between alternative strategies and alternative programs. Can a university justify its use of resources in Astronomy or Southeast Asian Studies, given the outputs, costs, and the alternative demands for scarce resources? Such incremental decisions must be made periodically, whether consciously or unconsciously and with or without relevant data. They presuppose, of course, some sense of institutional objective, some preference system, in terms of which choices can be made in light of the perceived alternatives. These preference systems will vary between institutions, and the parties at interest in any particular institution or in any given decision may operate with different preference systems. The outcome will depend, then, not only on the perceived alternatives and objectives or preference systems, but also on the collective decision process. In light of the diversity of educational objectives and preference systems and the variety of decision processes, a multiplicity of measures of output takes on special significance.

The importance of an incremental approach to improved decision-making should not be underestimated. There are many operational decisions in an individual institution that can be the subject of improved decision. In the battle for resources at the macro-level, evidence that decisions at the micro-level are based on careful analysis of relevant information and hard choices between alternatives, may be decisive.

Finally, since decisions are decentralized, it will often be useful to measure intermediate outputs, i.e., to identify points in the process of graduate education where changes in the inputs can have significant effects on the efficiency of the process. Thus, a decision might be made to change the allocation of resources between recruitment, selection, remedial education, and the normal education required for the degree. For example, "dropouts" may be reduced by better selection processes or remedial education. But at what cost?

Function of Graduate Education

By graduate education, I mean all postbaccalaureate education in the arts and sciences and the professions, including postdoctoral and continuing education.

I assume that the principal purposes of graduate education so defined are:

1. To add to the body of knowledge through research.
2. To disseminate the body of knowledge.
3. To increase the professional effectiveness of those participating in graduate education, including faculty and students. (This is clearly true of training for the Ph.D. and the recognized professional degrees; it is also true of much education of masters' candidates and of much continuing education.)

I assume that the basic elements of a student's character and values, and his preparation for citizenship are formed prior to embarking on graduate education and, consequently, that the measurement of such social benefits of graduate education is not a significant problem. To be sure, graduate education may strengthen or reinforce these qualities. And some students look upon graduate education, especially the first year, as simply an extension of the type of general education characteristic of the undergraduate college. Others conceive it as a period for testing out their interest in some line of graduate or professional work. But I see no reason, apart from socialization of a graduate student to the norms of his intended profession, to assume that such social benefits associated with a year of graduate study will, on the average, differ from those associated with alternative experiences such as a year of "employment." This is not to deny that there are social benefits other than the professional competence acquired that are associated with graduate education. But I believe that these benefits are subject to eventual diminishing returns in education as elsewhere and that, for most, the rate of return in terms of the social benefits in question will be low by the time of graduate study. Moreover, other uses of one's time, for example, employment in the world of affairs, offer similar benefits in the development of character, values, and preparation for citizenship — benefits which may be even greater than those from additional years of study because of the qualitative change in perspective.

The fact that these "social benefits" of the type indicated, although real, are not the primary effect of graduate education, should simplify the problem of measurement and decision in this area.

But while the principal purposes of graduate education are the search for new knowledge, the dissemination of knowledge, and the development of professional competence, decisions are often

affected by other objectives arising from social or political considerations. For example, the goal of "equal opportunity" directs attention to the recruitment and education of various minority groups and of women. The mix of students, admitted and educated, may have effects on inputs (e.g., the cost of remedial education for the culturally deprived) and on the final outputs however measured in various ways. At times, national policy with respect to the education of foreign students has led to similar special objectives in admission. Likewise, concern for the geographical distribution of educational opportunities and research facilities may also dictate special attention to the geographical dispersion of facilities for graduate education.

Process of Graduate Education

The process of graduate education may be classified under seven headings:

1. Recruitment and selection of students
2. Assembling of faculty
3. Acquisition and administration of resources, other than faculty, necessary for education and research
4. Education of the students (graduate, postdoctoral, and in-career students), including remedial education
5. Research
6. Provision of services to the community (e.g., practice teaching, internships, consultation)
7. Placement and replacement of students

There are several perspectives from which decisions concerning resource allocation to graduate education may be made. One can consider the allocation to graduate education as a whole or to particular systems or institutions. One can focus on functional sub-units such as different disciplines or professions; different levels of study such as masters, predoctoral, postdoctoral, and in-career study; or different stages in the process of graduate education, e.g., recruitment, selection, remedial work, education, or placement. It is relevant to consider how resources should be allocated between different disciplines and professions or between different degree programs. For example, was the postwar emphasis in the United States on science and on the training of college teachers with the Ph.D. at the expense of the support of the professions a wise allocation of resources? Is the current allocation of resources in medicine between research and teaching appropriate? Should the large prestigious universities devote so many resources to the search for talent of all sorts? Or only to search for talent among minority groups? Is the talent search of the Woodrow Wilson Fellowship Program worth the cost?

The variety of questions concerning the use of resources in higher education emphasizes again the need for a pluralistic definition of outputs and a complex system of measurement.

Outputs I: Value-added

The first instinct of an economist is to explore the concept of "value-added" by graduate education. This is, of course, a useful measure for judging the overall effectiveness of the total system of graduate education and of many subdivisions. It has the advantage of being expressed in the common denominator of money and, therefore, can be readily balanced against costs, which are to a large extent expressed in such terms.

But the value-added concept is not without difficulties. A good first approximation to value-added may be obtained by measuring the increase in the capitalized value of the income stream for those attaining a given level of graduate education over that of a control group of persons of similar prior achievement and potential who do not go on to graduate education. The control group might be a group who have completed the bachelor's degree with similar predictive scores for success in a given graduate program. The development of appropriate predictive scores does, of course, present difficulties. But standardized tests used for admission to graduate study in various disciplines and professions are useful in conjunction with corrected undergraduate grade records. But can we assume that groups with a similar distribution of test scores and grade averages have the same probabilities of performance? Is it not probable that the decisions to undertake or not to undertake graduate study reflect differences in motivations, values, or character that will affect earning power whether one undertakes graduate study or not? If so, what kind of correction would be necessary? It is conceivable that in some fields those who do not go on to graduate study may have less ambition and drive than those who do; if so, the value-added may be overstated. In other fields, those who undertake graduate study may be less able to cope with the world without such education than the control group; if so, without graduate education they might have had a lesser income than the control group; thus, the value-added may be understated. Can the significance of these possibilities be determined and, if they are significant, can we correct for them?

But the value-added accruing to the individual by way of money income may not be all the value-added. There are some free services rendered incidental to graduate study, e.g., legal aid or the services of interns. Moreover, many people render free public service throughout their lives (community and professional organizations, volunteer workers, etc.). Is the value of these free services rendered by those with graduate education greater or less than those rendered by people in the control group? If they are, the value-added by graduate education should be adjusted accordingly. It should not be impossible to make a sample survey that would throw light on this issue.

And what of the value-added by new knowledge resulting from research? If the knowledge is patented or copyrighted, the value-added as measured by the market will reflect the market value of the research. But if it is disseminated widely at no cost to those who benefit from it, the benefits will not be included in the private value-added. Can some allowance be made for these public benefits? This problem is not serious in some of the professional schools where research plays a lesser role than in the basic arts and sciences. Moreover, if the costs of teaching and research could be separated, the problem might be avoided. However, at the level of graduate education, teaching and research are inextricably entwined, and attempts to allocate costs are inevitably arbitrary. The problem remains.

The value-added as defined above can be used to measure output for various disciplines and professions on a nationwide, regional, or individual institutional basis. Likewise, this measure of output can be applied to groups classified by the number of years of study, degree obtained, sex, or by national, racial, or religious origin. The estimates are probably more accurate for the professional schools than for the graduate schools of arts and sciences because of the lesser role of research.

Outputs II: Other Measures

There are some other non-monetary measures of the outputs of the process of graduate education that are relevant to resource allocation.

Obvious gross measures of output are the number of man-years of study and number receiving different degrees. Man-years of study makes allowance for the education of those who do not complete the degree or who are enrolled for non-degree programs. Such education has value, and it is often a matter of conscious decision to provide it. Degrees granted are an obvious measure which may be particularly useful in allocating resources within an institution or in comparing the performance of similar institutions. But the measure is of limited use if the mix of degree and non-degree students educated jointly differs substantially.

Concern for "equality of opportunity" to participate in graduate education and in the life-styles and careers to which it leads, suggests an analysis of data on recruitment, admission, matriculation, and completion of the degree for various student population classified by sex, ethnic origin, religion, and geographical origin. Thus, it may be useful to compare the proportion of female baccalaureates applying to graduate school with that for men of the same potential, or black baccalaureates with white. A similar comparison of the ratio of offers of admission to applications may be useful as may the ratio of those receiving a graduate degree to the number matriculating or to the number receiving a baccalaureate. Each of these comparisons would throw some light on opportunity differentials in graduate education. The political and social significance of equalizing opportunities suggest the urgency of careful analysis of the flow of students of these various categories.

A comparative analysis of applications for various schools or an analysis of differences in the trends in the number and composition of applications may throw light on the effectiveness of recruitment or upon perceptions of a school's excellence. Such data must be interpreted with care, since applicants may be affected by such factors as changes in or differences in application fees, financial aid, and draft policies. But recruitment and selection of students involve costs. At some cost, more applications may be generated and better selection can be made. And at some cost in financial aid and other inducements, the rate of acceptance of offers can be improved. How should resources be allocated? To improve decisions concerning the allocation of resources, whether within an institution or on a national or state basis, involves better choices between expenditures on recruitment, selection, financial aid, faculty, and other resources (including housing and social facilities). This requires information concerning the responsiveness of certain intermediate outputs to inputs.

The analysis of those matriculating who complete their degree (and its reverse, the dropout rate) is another useful measure of output. Clearly the completion of a degree is only a measure of academic standards met. The significance varies between degrees, universities, departments, and individuals. Moreover, it will be affected by a variety

of factors such as the quality of matriculants, financial aid policy, standards of achievement required for the degree, as well as the effectiveness of the educational program. But trends and differences in the rate of completion of the degree may be relevant to the allocation of resources. The completion of some degrees, such as the LL.B., M.D., or Ph.D., may have more significance than the completion of an M.A. or M.S. degree, since in some institutions the latter degrees are awarded as a consolation prize or as a step on the road to the Ph.D. Many proceeding to the Ph.D. do not seek the masters degree, especially if a special fee is assessed. But if interpreted with care, statistics on the percentage of those completing various degrees will be relevant to decisions concerning the allocation of resources to graduate education.

The same is true of studies of the length of time required to complete the graduate degree. While many studies, especially those concerned with the Ph.D., have measured the length of time from the completion of the bachelor's degree to the completion of the advanced degree, for present purposes the time from the commencement of graduate study to completion of the degree or the years of registration may be more relevant. But there are real difficulties in this problem in the case of students engaged in part-time study and in the case of candidates for the Ph.D., because of the stretch-out in the process of completing the dissertation while fully or partially employed. Differences in practices concerning registration, financial aid, and rules concerning work in absentia confuse the meaning of these data, especially in the case of Ph.D. candidates.

Alumni Experience Indicative

An analysis of the employment experience of alumni may also be indicative of output. Alternate types of employment can be distinguished (teaching, research, government, business, professions, etc.) and differences and trends analyzed. Clearly these data must be analyzed with care, since they are affected not only by the quality of matriculants and the effectiveness of the educational process, but also by the changes in employment opportunities and the effectiveness of placement efforts.

Finally, in the matter of research some indices of differences and change are available. Data on the number of publications and the frequency of citations are available or can be devised. While these may not indicate whether the resources allocated to research are justified by the results, they may be useful for comparing the research effectiveness of similar departments in different institutions. It is true that research and publication are not always synonymous so that these measures are of limited value in comparing individuals. But our interest is not in micro decisions concerning the appointment of an individual but rather in measures as a guide to the allocation of resources at the departmental or higher level in situations where research *is* one of the valued outputs.

Each of these various quantitative measures of performance has serious limitations, some of which have been mentioned. Moreover, they do not provide a single valued measure of output, achievement, or effectiveness. But from them can be constructed a view of trends in the performance of various sectors of the world of graduate education or differences between sectors or institutions. The resulting view can be related to differences in the level or type of input. Such information can be useful at several levels in the effort to make better, although not necessarily the best possible, decisions. One advantage of such data is that they can be collected as part of the administrative routine of our graduate schools so that they can be kept current at little expense. In this respect they differ from data on value-added which are expensive to construct and difficult to keep current; moreover, they involve difficult projections of the future if they are to be relevant to recent performance. Another advantage of these data generated by the administrative process is that their generation need not affect the educational process although their use not only may, but it is hoped, will.

APPENDIX

AN ACCOUNTING STRUCTURE FOR THE OUTPUTS OF HIGHER EDUCATION: ONE PROPOSAL

Draft for Review Purposes Only

Instructional Outputs

Variables	Source of Measures
Cognitive Attributes of Students:	
Level of General Knowledge	Test Scores
Level of Knowledge in Chosen Field	Test Scores
Basic Language Arts Skills	Test Scores
Critical Thinking and Reasoning	Test Scores
General Intelligence	Test Scores
Affective Attributes of Students:	
Self-concept	Questionnaire Responses
Satisfaction with Educational Experience	Questionnaire Responses
Citizenship	Questionnaire Responses
Values	Questionnaire Responses
Achievement Motivation	Questionnaire Responses
Tangible Attributes of Students:	
Earning Power	Placement and Employment Data
Awards	Number and Stature of Awards
Affiliations	Number and Kind of Affiliations
Avocations	Number and Kind of Hobbies
G.P.A.	Academic Record Data
Level of Educational Attainment	Academic Record Data
Flexibility of Employment	Placement and Employment Data
Areas of Career Interest	Questionnaire Responses

Institutional Environment Outputs

Variables	Source of Measures
Academic Environment Attributes:	
Rate of Student Success	Dropout Data
Mean Time to Reach Degree	Student Record Data
Faculty Turnover	Faculty Record Data
Faculty Availability to Students	Student Questionnaire
Academic Resources Available	Library Data
Quality of Instruction	Faculty & Student Questionnaire
Academic Aptitude Mix	Entering Student SAT Scores
Student Stress	Student Questionnaire
Faculty Stress	Faculty Questionnaire
Social Environment Attributes:	
Degree of Social Activity on Campus	Activity Records and Questionnaire
Racial Mix	Student & Faculty Records
Socio-Economic Mix	Student Records
Family Attitude Characteristics	Questionnaire
Social Involvement of Student Body	Questionnaire
Per cent Resident (on campus) Students	Housing and Student Records
Rate of Marriage Among Students	Student Records
Physical Environment	Physical Plant Data and Questionnaire

Research Outputs

Variables	Source of Measures
Reorganization of Knowledge	Number of new books, textbooks, etc.
New Inventions and Developments (Applied Research Products)	Number of patents, adopted procedures, etc.
New Ideas and Concepts (Pure Research Outputs)	Number of articles, papers, awards, citations, etc.
Personal Involvement of Students and Others (instructional spinoff)	Number of hours involvement on projects by students, industry, personnel, etc.

Public Service Outputs

Variables	Source of Measures
Student Involvement in Community	Hours of time, type of project, questionnaire
Faculty Involvement in Community	Hours of time, type of project, questionnaire
Cultural Activities Available	Number, type, duration, attendance, participation
Recreation Activities Available	Number, type, duration, attendance, participation
Continuing Education Activities	Number, type, duration, enrollment, quality, and satisfaction, questionnaire
Social Criticism	Amount, frequency, intensity, effects of confrontation — Students and Community — Faculty and Community
Personal Services	Number of health care patients, counseling patients, psychological testing, legal advice requests, etc. (dollar value of such services)
Indirect Community Benefits	Students available as employees, drawing power of the community as a place of residence for professional and skilled persons
Community Psychic Income	Public pride, awareness that expertise is available if needed
Product Testing	Number and types of products and materials tested for government and industry

BIBLIOGRAPHY

BIBLIOGRAPHY

This selected bibliography is provided for your convenience. It was abstracted from a list of more than 1,500 references related to the subjects involved.

The first section includes those references the authors felt were germane to their topics, as well as other references that deal with specific output variables for their measures. Certain models and analyses of educational outputs inherently include variable definitions or measures, and, therefore, their references are included also. Because of the diverse and interrelated nature of the papers being presented, the first list includes a substantial number of references. Obviously not all of these are intended for any one paper. Instead this list is intended to provide a menu of references for the reader.

The second group of references is associated with related objectives, goals, and opinions in the area of the process and outputs of higher education.

The third list contains references dealing primarily with educational cost.

It is well understood that the attached bibliography is not complete or comprehensive. Rather it represents an attempt to restrict consideration of the wealth of references to those materials most closely related to the primary subjects of this seminar.

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Section II

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